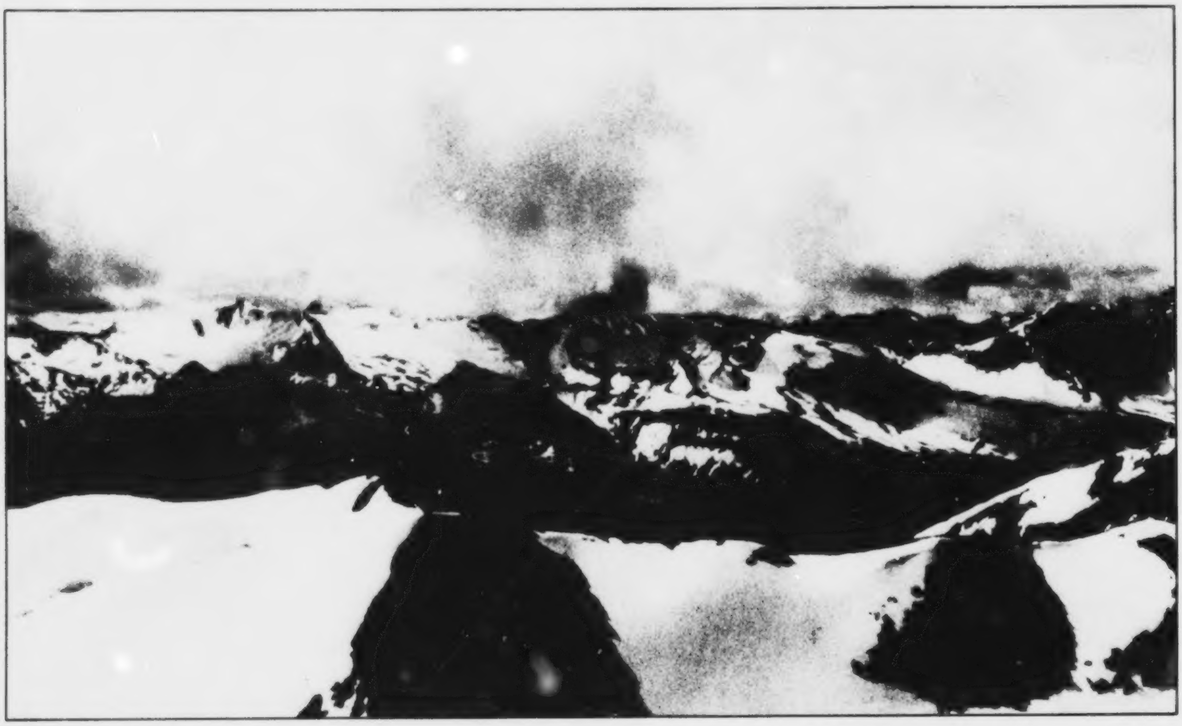
ANNOTATED BIBLIOGRAPHY: LATE QUATERNARY STUDIES IN ALBERTA'S WESTERN CORRIDOR 1950 - 1988

Alwynne B. Beaudoin



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1989

Alberta
CULTURE AND MULTICULTURALISM

ANNOTATED BIBLIOGRAPHY: LATE QUATERNARY STUDIES IN ALBERTA'S WESTERN CORRIDOR 1950-1988

by

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Alwynne B. Beaudoin

Archaeological Survey of Alberta

1989

ABSTRACT

This annotated bibliography includes papers, short notes, theses, conference abstracts and maps published between 1950-1988. The citations deal with surficial geology, glacial history, palaeontology and palaeoenvironments in the Western Corridor of Alberta between roughly 30,000 to 6,000 years BP. The bibliography includes about 650 citations. It was compiled primarily as a research aid for archaeologists and others involved in the Archaeological Survey of Alberta's "First Albertans" project - an investigation into the initial peopling of Alberta.

ACKNOWLEDGEMENTS

A number of people have helped me assemble this bibliography over the last two and a half years, and I would like to take this opportunity to thank them for their assistance.

In the course of this project, I have used the resources of several libraries and I am grateful to many staff members for assistance. Margaret Bhatnagar and her staff at the Historical Resources Division Library, Provincial Archives of Alberta, particularly Sandra Morden and Janet Williamson, have been most helpful. They were able to track down many obscure items for me.

The staff at various University of Alberta libraries were also very helpful. In particular, I would like to thank those manning the information desk of Cameron Library and also Jeannine M. Greene, Assistant Special Collections Librarian. Ronald Whistance-Smith, Map Curator of the William C. Wonders Map Collection, University of Alberta, assisted in finding maps and kindly checked over the maps section, pointing out a number of significant omissions.

The staff at the Alberta Research Council Publications Sales provided their Publications List and were prompt in fulfilling requests for materials.

Jean F. Tener, Archivist, University of Calgary Library, and her staff, were most cooperative in finding theses.

Dr. J.A. Burns, Curator of Quaternary Palaeontology at the Provincial Museum of Alberta, checked over the palaeontology sections and drew my attention to a number of additional papers and some new unpublished information. I am grateful for his comments.

I was fortunate to have some in-house assistance at various times during this project. Mary Bigelow proof read large sections and spent much time in various University of Alberta Libraries collecting materials. Dianne Schuldhaus catalogued references, proof read the manuscript and helped me with the library search. I greatly appreciated her assistance. With her help, the major part of this material was catalogued, filed and proof read. Carolyn Hind also helped with the literature search. Manjot Randhawa assisted with the final proofing and formatting of the document.

Thanks are also due to Wendy Johnson, who drew Figures 1 and 2, and to Martina Purdon, for answering dozens of questions on the correct formats for references.

I would also like to thank my colleagues at the Archaeological Survey and at other institutions who replied to my requests for information by furnishing copies of papers.

TABLE OF CONTENTS

Page

ABSTRACT vii

ACKNOWLEDGEMENTS ix

TABLE OF CONTENTS xi

LIST OF FIGURES xvii

INTRODUCTION AND ORGANIZATION OF THE BIBLIOGRAPHY 1
  BACKGROUND TO THE PROJECT 1
  DEFINITION OF THE PROJECT AREA 3
  SCOPE OF THE BIBLIOGRAPHY 3
    1. Areal coverage 3
    2. Temporal coverage 6
    3. Topical coverage 6
  SEARCH METHODOLOGY 7
  ORGANIZATION OF THE BIBLIOGRAPHY 8
    Section A: Papers 8
    Section B: Short Notes 8
    Section C: Theses 9
    Section D: Conference Abstracts 9
    Section E: In-house Reports, Field-Trip Guides, and Unpublished Papers . 10
    Section F: Maps and Charts 10
  LOCATION OF THE REFERENCES 11
  INDEXING THE REFERENCES 13
  OTHER ABBREVIATIONS 14
  UPDATES 14
  CAVEAT 14

SECTION A. PAPERS 15
  PART 1. LATE QUATERNARY GEOLOGY 15
    a. General 15
    b. Southern Western Corridor 33
    c. Central Western Corridor 56
    d. Northern Western Corridor 80
    e. Southeastern Alberta and Southern Saskatchewan 83

TABLE OF CONTENTS (continued)

Page

f. Central and East-Central Alberta 98
g. Northern Alberta 115
h. Northeastern British Columbia 119
i. Northern United States 123
PART 2. LATE QUATERNARY PALAEOENVIRONMENTS 128
a. General 128
b. Southern Western Corridor 134
c. Central Western Corridor 140
d. Northern Western Corridor 149
e. Central and East-Central Alberta 152
f. Northern Alberta 155
g. Northeastern British Columbia 156
h. Northern United States 157
PART 3. LATE QUATERNARY PALAEONTOLOGY 158
a. General 158
b. Southern Western Corridor 161
c. Central Western Corridor 168
d. Northern Western Corridor 172
e. Southeastern Alberta and Southern Saskatchewan 173
f. Central and East-Central Alberta 175
g. Northeastern British Columbia 177
h. Northern United States 179

SECTION B. SHORT NOTES 180
PART 1. LATE QUATERNARY GEOLOGY 180
a. Southern Western Corridor 180
b. Central Western Corridor 183
c. Northern Western Corridor 185
d. Southeastern Alberta and Southern Saskatchewan 186
e. Northern Alberta 189
f. Northeastern British Columbia 190
PART 2. LATE QUATERNARY PALAEOENVIRONMENTS 192
a. Southeastern Alberta and Southern Saskatchewan 192
b. Central and East-Central Alberta 193
c. Northern Alberta 194

TABLE OF CONTENTS (continued)

Page

PART 3. LATE QUATERNARY PALAEONTOLOGY 195
  a. Southern Western Corridor 195
  b. Southeastern Alberta and Southern Saskatchewan 196

SECTION C. THESES 197
PART 1. LATE QUATERNARY GEOLOGY 197
  a. Southern Western Corridor 197
  b. Central Western Corridor 210
  c. Northern Western Corridor 227
  d. Southeastern Alberta 228
  e. Central and East-Central Alberta 232
  f. Northern Alberta 238
  g. Northeastern British Columbia 242
PART 2. LATE QUATERNARY PALAEOENVIRONMENTS 243
  a. General 243
  b. Southern Western Corridor 244
  c. Central Western Corridor 247
  d. Northern Western Corridor 252
  e. Central and East-Central Alberta 253
PART 3. LATE QUATERNARY PALAEONTOLOGY 254
  a. General 254
  b. Southern Western Corridor 255
  c. Central and East-Central Alberta 257

SECTION D. CONFERENCE ABSTRACTS 258
PART 1. LATE QUATERNARY GEOLOGY 258
  a. General 258
  b. Southern Western Corridor 260
  c. Central Western Corridor 265
  d. Northern Western Corridor 270
  e. Southeastern Alberta and Southern Saskatchewan 271
  f. Central and East-Central Alberta 272
  g. Northern Alberta 273
  h. Northeastern British Columbia 274
  i. Northern United States 275

TABLE OF CONTENTS (continued)

Page

PART 2. LATE QUATERNARY PALAEOENVIRONMENTS 276
  a. General 276
  b. Central Western Corridor 278
  c. Northern Western Corridor 281
  d. Central and East-Central Alberta 282
PART 3. LATE QUATERNARY PALAEONTOLOGY 283
  a. General 283
  b. Northeastern British Columbia 284

SECTION E. IN-HOUSE REPORTS, FIELD-TRIP GUIDES, AND UNPUBLISHED PAPERS 285
PART 1. LATE QUATERNARY GEOLOGY 285
  a. General 285
  b. Southern Western Corridor 286
  c. Central Western Corridor 290
  d. Northern Western Corridor 294
  e. Southeastern Alberta and Southern Saskatchewan 295
  f. Central and East-Central Alberta 298
  g. Northern Alberta 299
  h. Northeastern British Columbia 301
PART 2. LATE QUATERNARY PALAEOENVIRONMENTS 302
  a. General 302
  b. Southern Western Corridor 303
  c. Central Western Corridor 304
PART 3. LATE QUATERNARY PALAEONTOLOGY 307
  a. Southeastern Alberta and Southern Saskatchewan 307

SECTION F. MAPS 308
PART 1. SURFICIAL GEOLOGY MAPS 308
  a. General 308
  b. Southern Western Corridor 309
  c. Central Western Corridor 313
  d. Northern Western Corridor 316
  e. Southeastern Alberta and Southern Saskatchewan 318
  f. Central and East-Central Alberta 319
  g. Northern Alberta 326

TABLE OF CONTENTS (continued)

Page

PART 2. MAPS AND CHARTS DEALING WITH OTHER TOPICS: GEOMORPHOLOGY, STRATIGRAPHY, ICE LIMITS AND BIOPHYSICAL ZONES 329
  a. General 329
  b. Central Western Corridor 331
  c. Southeastern Alberta and Southern Saskatchewan 332
  d. Central and East-Central Alberta 333
  e. Northern Alberta 334

REFERENCES 335

INDEX 339

LIST OF FIGURES

Page

Figure 1. Two recent interpretations of Late Wisconsinan ice-cover in Alberta 2

Figure 2. The Western Corridor with subdivisions of Alberta and adjacent areas used in this bibliography 4

INTRODUCTION AND ORGANIZATION OF THE BIBLIOGRAPHY

BACKGROUND TO THE PROJECT

This bibliography is a compilation of most of the published material relevant to a consideration of archaeological and palaeoenvironmental events in the "Ice-Free Corridor" area of Alberta in the Late Quaternary. Its purpose is to assist in the discussion of Late Quaternary events and environments in this region as they relate to the problem of the incursion of people into continental North America. It was originally intended primarily as a resource for archaeologists and other researchers involved in the Archaeological Survey of Alberta's "First Albertans" project.

The underlying hypothesis of the "First Albertans" project is that indigenous North Americans first populated the Continental interior by moving southwards along the eastern flanks of the Rockies and adjacent areas (Ronaghan and Beaudoin 1988; Ives et al. 1989). This population movement is postulated to have occurred after the Late Wisconsinan glacial maximum, when Laurentide and Cordilleran ice were not coalescent. The term "Ice-Free Corridor" has been used to describe the area east of the Rockies along which such population movement is hypothesised to have occurred (e.g. Reeves 1973).

The issue as to whether there was or was not an "Ice-free Corridor" extending from Alaska-Yukon to the contiguous United States in the Late Wisconsinan, and particularly during the time of maximum ice extent, is still contentious. Indeed, part of the impetus for compiling this bibliography was a desire to evaluate the available published evidence. Since the American Quaternary Association (AMQUA) meeting in Edmonton in 1978 whose theme was the "Ice-Free Corridor", a large amount of new information has been published on the region.

Rutter (1984) has argued that "an ice free corridor existed at least from the Edmonton-Jasper area southward to the International Boundary during Late Wisconsinan time" (Figure 1). Rutter (1984) points out that the Quaternary history of the area from Jasper-Hinton northward to the Peace River district is not well-known, and concedes the possibility that Laurentide and Cordilleran ice may have met in this region. This viewpoint is by no means universally accepted. The recent compilation by Dyke and Prest (1987), for example, shows nearly continuous ice cover from the British Columbia-Yukon border to Montana at 18,000 yr BP, the Late Wisconsinan maximum (Figure 1).

Much of this debate on chronology and correlation of glacial history and events arises from the limited number of unambiguous radiocarbon dates for Late Wisconsinan events in the Western Corridor (see, for instance, Jackson and Pawson 1984), and the virtual absence of firm dating control for most inferred pre-Late Wisconsinan events. This situation permits the construction of several alternate scenarios to fit the observed stratigraphic evidence.

From the perspective of the "First Albertans" project, on the basis of the evidence presently available, the constraining dates for migration at either end of the corridor are c. 15,500 yr BP, from Bluefish caves, Yukon (Morlan 1983:58), and about 11,500 yr BP from

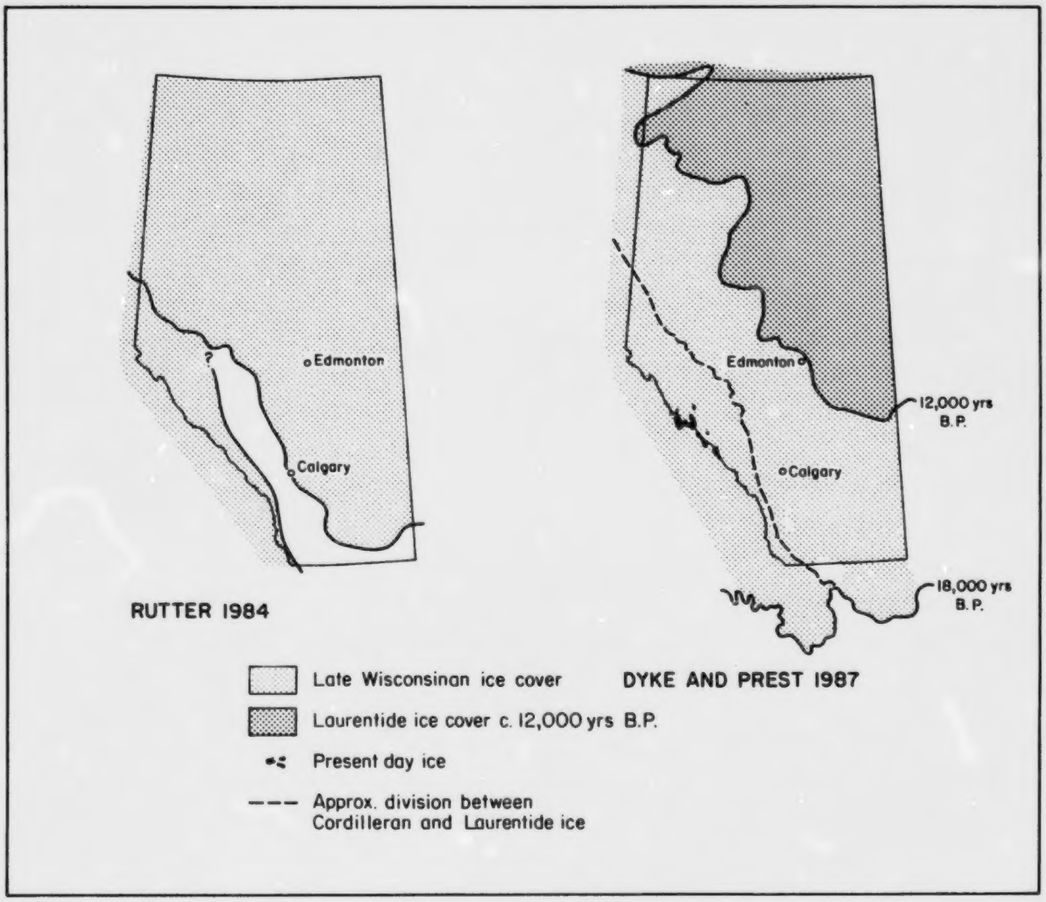
?
Edmonton
Calgary
RUTTER 1984
Edmonton
Calgary
12,000 yrs B.P.
18,000 yrs B.P.
DYKE AND PREST 1987
Late Wisconsinan ice cover
Laurentide ice cover c. 12,000 yrs B.P.
Present day ice
Approx. division between Cordilleran and Laurentide ice

Figure 1: Two recent interpretations of Late Wisconsinan ice -cover in Alberta

many well-dated Clovis sites in North America south of the Late Wisconsinan Laurentide ice margin (West 1983:Table 18-1). Thus the time-frame of most concern in this project is the few millennia prior to 11,500 yr BP. Specifically, the project hypothesis is that North America south of the Laurentide ice sheet was probably first peopled sometime after the Late Wisconsinan glacial maximum and prior to 11,500 yr BP. Thus the timing of deglaciation and the landscape characteristics and environmental events in the Late Wisconsinan are of major importance to the project. Most reconstructions of ice limits show predominantly ice-free conditions in most of Alberta, and certainly in the critical "Ice Free Corridor" area, by about 12,000 yr BP (Figure 1). Hence the ice cover itself would not have posed a migration barrier at this time.

DEFINITION OF THE PROJECT AREA

Because of the controversy surrounding the "Ice Free Corridor" concept, that term is not used in this paper. Instead, the area of concern is named the "Western Corridor" (Figure 2). The Western Corridor, as defined for this bibliography, consists of the area bounded by the Alberta-British Columbia border to the west, and a line joining Foremost and Fairview to the east (Figure 2). By this definition, the Western Corridor encompasses a much broader area than that usually evoked by the term "Ice-Free Corridor", which generally refers to areas between inferred Late Wisconsinan maximum ice-marginal positions. The broader definition of the Western Corridor was chosen quite deliberately so as to include most of the hypothesised Late Wisconsinan maximum ice marginal positions together with adjacent areas important to a consideration of Late Quaternary events.

SCOPE OF THE BIBLIOGRAPHY

The major decisions involved in assembling this bibliography were related to setting limits on the search. The area to be included, the temporal framework, and the topics to be covered all required strict definition and limitations if the amount of material acquired was not to become unmanageable. However, an effort was made to select meaningful temporal and spatial limits.

1. Areal coverage

Materials dealing with areas within the Western Corridor are included when they have a bearing on Late Quaternary chronology or conditions in this region. An intensive search has been made for materials dealing with the Western Corridor area, and thus the coverage for this area should be fairly complete. For the purposes of this bibliography, the Western Corridor is subdivided into three regions (Figure 2).

The Southern Western Corridor (Figure 2, Area A) consists of the area from the United States-Canadian border to about the southern boundary of Banff National Park (49°-51° N). The areas immediately to the west of the provincial boundary, particularly the Elk Valley, are also included in this subdivision.

The Central Western Corridor (Figure 2, Area B) includes Banff and Jasper National Parks and extends north to about Grande Cache (51°-54° N). Again, some areas west of the Continental Divide, mainly in Yoho National Park, are included in this subdivision.

The Northern Western Corridor (Figure 2, Area C) comprises the area from Grande Cache to the Clear Hills (54°-57° N) and consists mainly of the Peace River valley and adjacent areas.

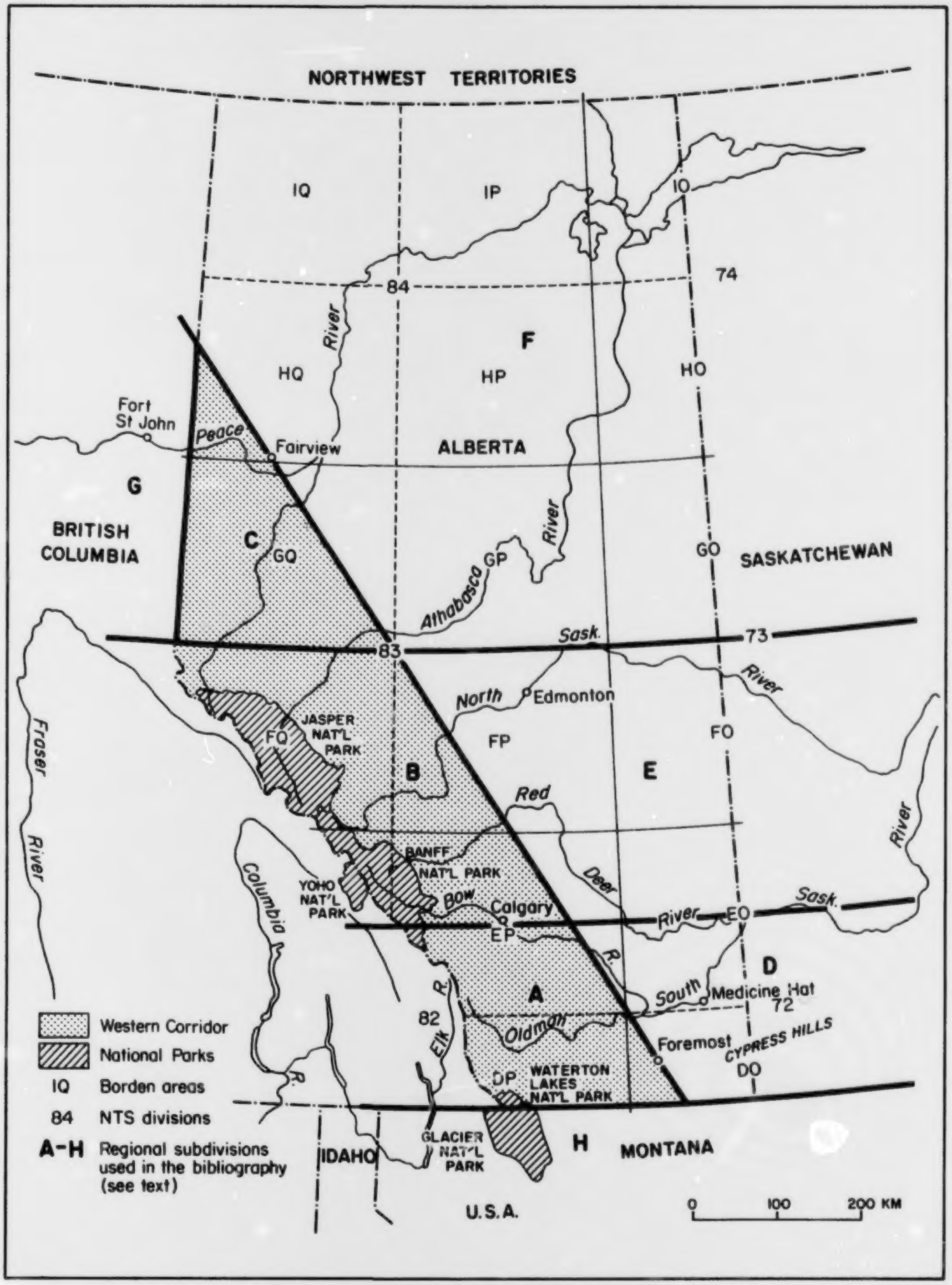
NORTHWEST TERRITORIES
IQ
IP
IO
74
84
F
HQ
HP
HO
River
Fort St John
Peace
Fairview
ALBERTA
G
BRITISH COLUMBIA
C
GQ
Athabasca
GP
River
GO
SASKATCHEWAN
83
Sask.
73
River
North
Edmonton
Fraser
River
JASPER NAT'L PARK
FQ
B
FP
FO
E
Red
River
Columbia
BANFF NAT'L PARK
YOHO NAT'L PARK
Deer
Bow
Calgary
River
EO
Sask.
EP
R.
D
A
South
Medicine Hat
72
82
Elk
R.
Oldman
Foremost
CYPRESS HILLS
R.
DP
WATERTON LAKES NAT'L PARK
DO
GLACIER NAT'L PARK
H
MONTANA
IDAHO
U.S.A.
0
100
200 KM
▒ Western Corridor
▨ National Parks
IQ Borden areas
84 NTS divisions
A–H Regional subdivisions used in the bibliography (see text)

Figure 2: The Western Corridor with subdivisions of Alberta and adjacent areas used in this bibliography

Although the main focus of research is the Western Corridor, some references from outside this region are also included. However, since these adjacent areas were not the main focus of the research, their coverage is unlikely to be complete. These materials on adjacent regions are categorised into five additional sections, as follows:

Southeastern Alberta and Southern Saskatchewan (Figure 2, Area D) includes the area from the International Boundary (49°N) as far north as 51°N. It includes the area around Medicine Hat. The Cypress Hills, extending across the provincial boundary to adjacent areas of southwestern Saskatchewan, are also included in this section. Materials dealing with this area are included because of the importance of the sections and mammalian fossils in a consideration of Quaternary events in Alberta and because of the proximity to the inferred southern margin of the ice cover (Figure 1).

Central and East Central Alberta (Figure 2, Area E) covers the area outside the Western Corridor between 51°-54°N. Adjacent areas of Saskatchewan are also subsumed under this category. The area is included because it encompasses the margins of the Laurentide ice sheet and is critical to a consideration is Late Wisconsinan glacial chronology.

Northern Alberta (Figure 2, Area F) comprises the rest of Alberta outside the Western Corridor and north of 54°N as far as the Alberta-Northwest Territories border. This area is perhaps the least well known part of Alberta in terms of its glacial and palaeoenvironmental history. However, there is an increasing amount of evidence, such as the work of Vance (1986), from this area which is shedding light on the sequence of events further to the south.

Northeastern British Columbia (Figure 2, Area G) includes the area contiguous to the northern part of the Western Corridor in Alberta. It comprises the Peace River district of British Columbia and adjacent areas of the Rocky Mountain trench. Material from this region is included because the region is the extension of the Western Corridor into British Columbia. It appears likely that Cordilleran ice from this region extended eastwards into Alberta (Mathews 1980; Bobrowsky 1989). Significant archaeological remains, such as those from Charlie Lake Cave (Fladmark et al. 1988) also occur in this region.

The Northern United States (Figure 2, Area H) includes areas of Montana, particularly Glacier National Park, and Wyoming. This area includes the southernmost limit of the Laurentide ice sheet (Figure 1) and may be expected to yield information on the timing and extent of ice at Late Wisconsinan maximum.

These nine areas (Figure 2, Areas A to H) are used as the basis for subdividing the materials within each section of the bibliography. An additional tenth category, General, was included for references which have broad areal coverage, or which deal with Alberta or Western Canada as a whole. These are generally review papers. An attempt was made to include the most recent review papers in each of the three major subject categories. However, to avoid repetition in the Quaternary geology category, the many interim statements associated with the IGCP (International Geological Correlation Programme) Project 24 have not been included.

2. Temporal coverage

Temporally, the material in the bibliography deals mainly with the Late Wisconsinan glaciation and early Holocene events, roughly spanning the time between 30,000 yr BP and 6,000 yr BP. The earlier date ensures that the close of the Middle Wisconsinan non-glacial interval and the onset of the Late Wisconsinan glaciation, probably sometime after 25,000 yr BP (Fulton et al. 1984), are included. The Mazama tephra, dated about 6800 yr BP (Bacon 1983), is a chronostratigraphic marker which occurs in sections throughout much of Alberta, particularly in the Western Corridor, and so provides a convenient and readily-defined later boundary. Some of the records from the Medicine Hat area fall outside these temporal limits but are included because of their importance to the overall picture of Quaternary history in Alberta. Some studies concerned exclusively with the Holocene have also been included. These are mainly palaeoenvironmental studies which have a bearing on the early Holocene conditions in the Western Corridor and adjacent areas.

An arbitrary publication date of 1950 was chosen as the cut-off date for the literature search. Publications prior to this date do not generally include chronologic control, whereas later papers may include radiocarbon dates. However, a few references published prior to 1950 are included, generally because they are widely cited or are part of a limited amount of material on their subject. The literature search was completed for publications issued to the end of 1988.

3. Topical coverage

Three major topics were used as a basis for the search: Late Quaternary geology, palaeoenvironmental studies, and palaeontology.

Late Quaternary geology was included as a topic because the chronology and character of glaciation and postglacial events set the background for the landscape into which the First Albertans moved. This topic includes material dealing primarily with surficial deposits and their stratigraphy, together with glacial history. Although some studies dealing mainly with sedimentology and geomorphology are included, processes studies are excluded. Papers dealing with Neoglacial events are also excluded. Some palaeosol studies are included, although studies whose main focus is on soil processes or pedogenesis are not given. Because of their importance as chronologic markers, a few publications dealing with tephras are included. However, papers whose focus is on Late Holocene tephra or are focussed on tephra and its impact on pedogenesis are not included. Studies dealing with geoarchaeology may also occur in this section.

Late Quaternary palaeoenvironmental topics include pollen studies together with studies on other remains, such as molluscs and diatoms. A number of palaeoenvironmental studies on lakes from Alberta are concerned primarily with the Late Holocene; these have not been included. Studies focussed on limnology are also excluded. Most dendrochronological studies are also focussed on the Late Holocene and thus are not presented. Some geoarchaeological studies, whose focus is primarily palaeoenvironmental, are included in this section.

Late Quaternary palaeontology topics were included as a separate category because of the importance to archaeologists of Late Pleistocene faunal remains, both as a chronologic control and as potential food resources for early inhabitants of Alberta. Some of the of the faunal remains from the Medicine Hat - Wellsch Valley area fall outside the defined temporal limits, but are included for completeness because they form such a major segment of the Quaternary faunal remains in the Province. However, studies whose prime focus is taxonomy are not included.

SEARCH METHODOLOGY

At the outset of this project, a large selection of papers dealing mainly with Late Quaternary events and environments of Jasper and Banff National Parks was available from personal collections. Bibliographies in these papers were searched for relevant publications. These were then obtained and searched in their turn. Most of the material in this bibliography was acquired by this means. In addition the following journals and publications were searched systematically:

Bulletin of Canadian Petroleum Geology
Canadian Journal of Earth Sciences
Géographie physique et Quaternaire
Geological Society of America Bulletin
Quaternary Science Reviews
Quaternary Research

The Geological Survey of Canada Index to Publications (Geological Survey of Canada 1985; Griffin 1980; Griffin 1975; Johnston 1961) was also searched, as was the Natural Resources Information Directory (Perrin 1985) and the Alberta Research Council's (1986) List of Publications. Abstracting journals were not found particularly useful in this search, since the areal definition was rarely stringent enough to decide if the papers cited therein were relevant. On-line search services were not used.

The material included in this bibliography was mainly found through searching the Historical Resources Division Library and the University of Alberta Library holdings. Some material was obtained from other library holdings by Interlibrary Loans. Other material was acquired from various other sources, mainly through loans from personal collections.

ORGANIZATION OF THE BIBLIOGRAPHY

The material included in this list consists mainly of published papers, short notes, and conference abstracts, together with some theses, unpublished papers, and maps. The material is organized into six sections. Within each of the first five sections, Sections A to E, the references are arranged first by major topic and then subdivided on the basis of area. In the last section, Section F, which deals with maps, the material is arranged by map theme.

Section A: Papers

This section includes principally papers published in refereed journals, together with published reports, such as Geological Survey of Canada Memoirs. It also includes papers published in symposia and conference proceedings, together with a few serial publications, such as the Syllogeus series, that are generally available in libraries. Short notes which are comments on or discussion of papers already included in the bibliography are also included in this section.

To make this section more useful, whenever they were provided by the author(s), abstracts for the papers have been included. Except where otherwise noted, the authors' original, unmodified abstract is given in all cases. Abstracts are presented exactly as given in the source. Obvious typographical errors have been corrected but no attempt has been made to systematize style, thus English or American spelling may occur, and various forms of expressing terms such as ^{14}C, for example, have been retained. In a few instances, where an abstract was not provided, the author's introduction or summary has been edited as a substitute abstract; in these cases, the source for the abstract is indicated following the text. A few papers were not amenable to this treatment and for these there is no abstract.

This is similar to the format of several recent bibliographies dealing with similar topics (e.g. Harington and Rice 1984; Andrews 1984). Occasionally short explanatory notes are appended to the references where locational information or supplementary relevant information is available.

Section B: Short Notes

This section consists of short notes. Most of these are summaries of work in progress from the "Report of Activities" of the Geological Survey of Canada. In many cases these summaries were subsequently followed by a Geological Survey of Canada Paper or Memoir, which would be included in Section A. No abstracts are available for most of these publications.

These notes are included since in some cases they may be the first report of significant information (e.g. Harrison 1976) or the only published report of some information (e.g. Lichti-Federovich 1972).

Section C: Theses

This section comprises theses. An exhaustive search of the literature for theses was not undertaken because of the difficulties of obtaining them to read. In many cases, information from theses would subsequently have been included in published papers, listed in Section A. Whenever a thesis could be obtained, its abstract is included. In a few instances, the abstracts were obtained from "Dissertation Abstracts International", because a copy of the thesis was not always available.

Theses in the University of Alberta Special Collections and University of Calgary Archives do not circulate. However, many theses produced at Canadian universities, particularly at the Ph.D. level, can be obtained from the National Library of Canada, Ottawa. Often, theses may only be available in microfiche or microfilm format.

Section D: Conference Abstracts

This section consists of a list of conference abstracts from major conferences such as AMQUA Biennial Meetings, INQUA Congresses, GAC Annual Meetings, and GSA Meetings. Abbreviations used in listing the conferences in this section are as follows:

AMQUA - American Quaternary Association
CAG - Canadian Association of Geographers
CAGONT - Canadian Association of Geographers, Ontario Division
CANQUA - Canadian Quaternary Association
CGU - Canadian Geophysical Union
ELDAAG - East Lakes Division of the American Association of Geographers
GAC - Geological Association of Canada
GSA - Geological Society of America
INQUA - International Union for Quaternary Research
MAC - Mineralogical Association of Canada

Access to conference abstracts is often difficult. Although most conferences do produce a "Programme and Abstracts" volume, these are generally not obtainable from libraries. In many cases, abstracts can only be obtained from the authors or from one of conference participants who has retained a copy of the volume.

Section E: In-house Reports, Field-Trip Guides, and Unpublished Papers

This section consists of a miscellaneous assortment of unpublished reports and papers, and articles from in-house publications, together with a large number of field trip guides. Most unpublished reports and papers receive only a limited distribution or are not generally available, hence this list is unlikely to be exhaustive. Many of these references, particularly field trip guides, are not available in libraries, and are only found in personal collections. In many instances, copies of the field trip guides may only have been provided to the field trip participants and organisers. However, field trip guides often contain valuable literature summaries for a particular area and descriptive information not available in other sources. Hence, their inclusion was felt to be worthwhile. Whenever possible, abstracts have been included.

Section F: Maps and Charts

The arrangement and range of material found in this section varies from that in the rest of the bibliography. The first part of this section comprises surficial geology maps dealing with the Western Corridor area. In many instances, the surficial geology map is associated with a report or memoir which is also included in Section A. The information for the maps in Section F was mainly obtained from Perrin (1985) and from Alberta Research Council (1986). Many of the surficial geology maps produced for the Alberta Research Council are associated with Open File Reports. Copies of these reports can be purchased from Alberta Research Council Publications Sales, but are not generally available in libraries. Hence these Open File Reports are not included in Section A as well, although a few are included in Section E.

The second part of this section consists of an assortment of maps and charts dealing with a variety of topics. It includes maps of glacial limits, geomorphological maps and wall charts.

In addition to surficial geology maps, there are a large number of Soil Survey maps and reports available for Alberta. Many of these are listed by Perrin (1985) and have not been listed separately in this bibliography. Similarly, with a few exceptions, Ecophysical or Biophysical Landscape Reports, such as those produced for Alberta Environment (e.g. Strong and Leggat 1981; Strong 1979) are listed by Perrin (1985). Many of these reports do contain some information on geomorphology or landscape types, but generally have little chronological information. Aggregate inventories and hydrogeology maps may provide some information for areas of Alberta that are as yet unmapped for surficial geology. Again, these are listed by Perrin (1985).

LOCATION OF THE REFERENCES

In order to make this bibliography more useful, some additional information and annotations are given following most of the references. This information includes source and/or library location, map and Borden areas of the study region or site examined in the reference, and an indication of the main topics discussed.

The library location of the reference, together with its call number, when known, is included. This bibliography was primarily intended for local use, by researchers within Alberta. Hence, most of the library locations given are in Alberta. The majority of the references were obtained through the University of Alberta Library System and/or the Historical Resources Division Library System. In many cases, several locations and call numbers are presented.

The abbreviations used for the main library locations follow the Symbols of Canadian Libraries, as recommended by the National Library of Canada (1987). These abbreviations are as follows:

- ACIA - Parks Canada, Western Region, Calgary
- ACSP - Institute of Sedimentary and Petroleum Geology, Geological Survey of Canada, Calgary
- ACU - University of Calgary Library, Calgary
- AE - Edmonton Public Library, Main Branch, Edmonton
- AEA - Historical Resources Division Library, Edmonton, including:
  - ADTMP - Tyrrell Museum of Palaeontology, Drumheller
  - AEPAA - Provincial Archives, Edmonton
- AEEN - Alberta Environment Library, Oxbridge Place, Edmonton
- AEU - University of Alberta Library, Edmonton
- AEUB - Boreal Institute for Northern Studies, University of Alberta

There are several locations within the University of Alberta and University of Calgary library systems where publications may be found.

The University of Alberta library system includes:

- GOVPUB - Government Publications, in the Cameron Library
- HSS - Humanities and Social Sciences, in the Rutherford Library North
- PMC - Periodicals and Microform Centre, in the Rutherford Library South
- SCI - Science and Technology, in the Cameron Library
- SPCOLL - Bruce Peel Special Collections Library, in the Rutherford Library South

The previous codes are those that would be found by searching the Library's On-line Catalogue. There is also a Map Library on the University of Alberta campus, although it is separate from the main library system. For the purposes of this bibliography only, the following code is also used:

UA, WCW - University of Alberta, William C. Wonders Map Collection, Tory Building

The University of Calgary library system also includes:

UARC - Archives, MacKimmie Library
Mic. - Microform Centre, MacKimmie Library

The Research Council of Alberta has several library locations. Their main library is coded as follows:

AER.MW - Alberta Research Council, Main Library

However, many Research Council publications are also available through their Publications Sales department which, for the purposes of this bibliography, is coded as follows:

ARC - Alberta Research Council, Publications Sales

A number of archaeological journals and publications are kept in a small branch library of the Historical Resources Division library at Old St. Stephen's College, the location of the Archaeological Survey of Alberta. In this document, this library is coded as follows:

AEA, HSS/ASA - Old St. Stephen's College, Edmonton

In addition, the annotations also include sources for publications which were not immediately available through local libraries. These include:

DAI - Dissertation Abstracts International
IC - Individual collection
ILL - Inter-Library Loan

A number of references could not be traced through the library system, and were only available through loans from private collections, coded "IC". In general, few publications of this type have been included, other than conference abstracts and field trip guides, because they are so difficult to obtain and are not widely available. For similar reasons, documents cited in the sources as "Unpublished manuscript in possession of the author", "Manuscript in preparation", "In press", or a similar category, have not been included in this bibliography.

Where materials have been obtained through inter-library loans, the source library is indicated if known. The codes for the source libraries follow National Library of Canada conventions. The following codes may occur:

ACAC - Amoco Canada Petroleum Co. Ltd., Calgary
ACM - Mobil Oil Canada Ltd., Calgary
MWU - University of Manitoba, Winnepeg
OOG - Geological Survey of Canada, Ottawa

Material from inter-library loan was obtained through an Alberta library if possible. Holdings of periodicals in Canadian libraries are listed in the Union List of Scientific Serials in Canadian Libraries (Canada Institute for Scientific and Technical Information, 1985). However, users should consult the inter-library loan division of their own library for advice on obtaining material from their nearest library location.

INDEXING THE REFERENCES

Following the location of each reference, some additional information is listed. This information has been used to compile an index which can be found at the end of the bibliography.

Each reference in Alberta is coded according to the area it discusses within the NTS sheet numbering system and within the Borden system (see Figure 2). The Borden system is an index scheme used in Canada for locating and cataloguing archaeological sites; readers unfamiliar with this system are referred to Borden (1952) for an explanation. References are coded by their major Borden block (e.g. DP) within Alberta. Areas outside Alberta are not generally listed by Borden block; instead, their regional coverage would be included under map areas.

References are coded by the relevant 1:250,000 NTS map area if they refer to a single site (e.g. Chalmers Bog) or to a specific restricted area within that map sheet. If appropriate, the reference may be coded by several maps. When the author(s) did not provide a location map for the area under discussion, the general map area is indicated. References to areas outside Alberta (e.g. Northwest Territories) are listed by their geographic region.

Finally, each reference is coded by topic(s). A number of general categories are used, e.g. glacial geomorphology. In addition, when the reference is dealing with a limited, specific topic, this is also codified. These topics are also indexed. The topics are chosen so as to reflect the main foci of each paper. Thus, for example, while many papers may mention sections or deposits, only a limited number deal with stratigraphy as a main topic.

Each reference is indexed by author(s), map and Borden area(s), and topic(s) and thus appears under several categories in the index. Some authors (e.g. Osborn, Reeves) are not consistent in their initials in publications. Since names are indexed exactly as given in the original source, some writers may appear under several entries in the index.

OTHER ABBREVIATIONS

In addition to the codes already discussed, the following abbreviations are also used in this manuscript:

AES - Atmospheric Environment Service
GSC - Geological Survey of Canada
N.A. - not applicable, or not available
n.d. - no date
NTS - National Topographic System

UPDATES

It is my intention to maintain this bibliography and to produce periodic updates. I would much appreciate receiving copies of any new publications which might be relevant to future updates of this bibliography.

CAVEAT

This bibliography is intended purely as an information resource. Although every attempt has been made to be accurate, consistent and comprehensive, omissions and mistakes are bound to have crept in. I acknowledge responsibility for errors and would appreciate having my attention drawn to them. I would also be glad to be informed of any significant omissions.

SECTION A. PAPERS

PART 1. LATE QUATERNARY GEOLOGY

a. General

Antevs, E.
1948 The Great Basin, With Emphasis on Glacial and Postglacial Times. University of Utah Bulletin 38(20):168-191.

Abstract : No abstract available
Location : IC
Areas : Map areas - Canada - Western, United States - Western
Borden areas - regions as above
Topics : Archaeological sites, Glacial history, Glacial lake sequences, Ice-free corridor, Tephra - Mazama

Antevs, E.
1945 Correlation of Wisconsin Glacial Maxima. American Journal of Science 243A:1-39.

The first maximum of the Wisconsin glaciation was the Iowan, which as far as known was limited to northwestern North America west of the 95th meridian and the upper Mississippi River. Several millennia later, when the western ice was at a minimum, the Labrador-Patricia ice sheet attained its Tazewell and Cary maxima. Still later the Cordilleran and Keewatin ice sheets had a second culmination, the Mankato. The two widely spaced maxima of the western ice with great intervening retreat, the intermediate culmination of the eastern ice, and the essentially independent expansions and shrinkings of the western and the eastern ice sheets are significant.

The formation and history of the ice sheets is tentatively explained by Enquist's hypothesis in modified form. The glaciation is believed to have started in the mountains of western Canada, because of a fall of the summer temperature, and to have spread to the plains on their east side. The relatively low saddle region of the Rocky Mountains between Lat. 54° and the St. Elias Range is assumed to have become depressed some 2000 to 8000 feet permitting cyclones relatively free entry to build up and maintain the huge Keewatin ice sheet. In the mountains of Labrador extensive glaciation is believed to have set in after the Cordilleran-Keewatin and the Scandinavian ice sheets had grown large and had caused a southward displacement of the Iceland barometric low, and this in turn had induced frequent northeast winds in Labrador. First then was the snowfall large enough for the formation of piedmont glaciers and an ice sheet. Well started, the Labrador ice sheet was largely nourished by cyclonic precipitation in its southern border belt.

The permanently cold air over the western ice caused the Aleutian barometric low to persist throughout the year. As a consequence western North America had cyclonic precipitation at all seasons, not only in the winter. With cold polar air occupying increasingly large areas, the cyclone tracks were shifted southward. Owing to these two conditions, precipitation in the western United States was much heavier than at present. The lower temperature considerably checked melting and evaporation. Climatic conditions induced by the western ice sheets thus led to the formation of glaciers and lakes in the mountains and basins of western United States. On the other hand these glaciers and lakes were little influenced directly by the eastern ice sheets. Ultimately the ice sheets grew too large and extended too far south for the nourishment to replace the enormous loss through wastage. The ice sheets had reached their maxima and withdrew. The Aleutian low may have remained mostly in southeasterly positions for some time, and storms may thus have continued to take southerly routes. As a consequence the mountain glaciers and the lakes may have attained their maxima during the first stage of retreat of the ice sheets. Later the storm tracks moved northward and brought about a rejuvenation of the ice sheets and a repetition of the events.

The mountains on both sides of the Great Basin and the Plateaus contain records of two relatively young, yet distinctly separate, glacial maxima, for which the Tahoe and the Tioga, distinguished by Blackwelder in the Sierra Nevada, may serve as types (see Table II). A reexamination of the history of the pluvial lakes Bonneville in Utah and Lahontan in Nevada also reveals two well separate high-water stages, comparable in age to the maxima of the mountain glaciations. These are called the Bonneville Pluvial and the Provo Pluvial.

The two maxima of Wisconsin continental glaciation in northwestern North America, of mountain glaciation in the western United States, and of pluviation in the Great Basin are clearly correlatives: the Iowan and Tahoe Glacials and the Bonneville Pluvial; the Mankato and Tioga Glacials and the Provo Pluvial.

Location : IC, ACAC
Areas : Map areas - All Alberta, All Canada, North America
Borden areas - All Alberta, regions as above
Topics : Review of glacial history

Bayrock, L.A.
1965 Incomplete Continental Glacial Record of Alberta, Canada. Proceedings 7th International Congress, International Quaternary Research, Boulder, Colorado, August 30-September 6, 1965. In Quaternary Geology and Climate, Publication 1701, pp. 99-103. National Academy of Science, Washington, D.C.

The Saskatchewan Gravels are deposits of sand and gravel in Alberta that underlie clearly recognizable glacial deposits and overlie Cretaceous and Paleocene shale and sandstone. That the gravels antedate continental glaciation of the province is supported by the fact that they do not contain any material from the Canadian Shield, unlike all other continental glacial deposits in western Canada and United States. The Saskatchewan Gravels occur as valley fills of rivers that may be correlated with Alden's (1932) bench No. 3. Recent fossil evidence suggests that these deposits are of late-Pleistocene age: it seems possible that they may have been deposited as recently as early Wisconsin but before the Wisconsin ice sheet had spread into this region. Because the Saskatchewan Gravels occur throughout Alberta and parts of Saskatchewan, it is evident that these areas were not glaciated during the earlier glaciations. It is suggested that only the Wisconsin ice sheets covered this region, and that during all previous glaciations the terrain from Montana to the Arctic Ocean along the Rocky Mountains was free of ice.

Location : AEU, SCI, QE 77. W94
ARC, Contribution Series No. 302
Areas : Map areas - All Alberta, Saskatchewan - Western
Borden areas - All Alberta, region as above
Topics : Ice-free corridor, Glacial chronology, Quaternary stratigraphy - Saskatchewan gravels and sands

Bayrock, L.A., and S. Pawluk

1967 Trace Elements in Tills of Alberta. Canadian Journal of Earth Sciences 4:597-607.

Analysis of 475 Keewatin till samples from the Alberta Plains shows well-defined trends in the distribution of certain minor constituents and trace elements. Fe and Cu are most abundant in tills from the Clear Hills region of northwestern Alberta, in which area thin but widespread beds of iron-formation outcrop. Zn distribution in till also is related to bedrock composition and, together with Fe and Cu, is useful in delineating bedrock subcrop patterns. The distribution of CaO, although related to the carbonate content of the underlying bedrock on a regional scale, has been modified to some extent by glacial processes, as demonstrated in the Caribou Mountains area of northernmost Alberta.

Location : AEU, SCI, QE 1. C212
AEPAA and ADTMP, Periodicals collection
ARC, Contribution Series 378
Areas : Map areas - All Alberta except Mountains and Foothills
Borden areas - All Alberta except Mountains and Foothills
Topics : Till - trace elements

Bretz, J.H.

1943 Keewatin End Moraines in Alberta, Canada. Geological Society of America Bulletin 54:31-52.

The outermost Keewatin moraines, within sight of the Rocky Mountains, are as youthful topographically as is the Late Wisconsin Altamont terminal moraine in eastern Alberta and western Saskatchewan. Differences in outline of the ice front, however, indicate that all moraines west of the Altamont are the product of an earlier advance. The moraine pattern records a southern Alberta convexity or lobe, limited on the west by the foothills of the Rocky Mountains and on the south by the Arctic Ocean-Gulf of Mexico divide. A complicated succession of melt-water dischargeways and associated glacial lakes is intimately related to the moraine succession. Escape of all this drainage was across the divide and to the Missouri River in Montana. Correlation of discontinuous moraine units is possible because drainage held close to the edge of the Keewatin ice sheet as it retreated down the slope of the Great Plains. Moraine outside (higher than) any one drainage channel thus is older than moraine inside (lower than) the channel.

Location : AEU, SCI, QE 1. G341
Areas : Map areas - 72 E, 72 L, 72 M, 73 E, 73 D, 82 G, 82 H, 82 NE, 83 SE, 83 SW
Borden areas - DO, DP, EO, EP, FO, FP, FQ
Topics : Glacial geomorphology - moraines, Glacial chronology

Clayton, L., and S.R. Moran

1982 Chronology of Late Wisconsinan Glaciation in Middle North America. Quaternary Science Reviews 1:55-82.

We propose a chronology of late Wisconsinan glacial fluctuations in middle North America, from Alberta to Wisconsin, based on radiocarbon dates derived solely from wood. Previous chronologies of the southwestern margin of the North American Continental Ice

Sheet have depended to a considerable degree on radiocarbon dates from fine-grained organic sediment. This material is commonly contaminated with older carbon, resulting in chronologic confusion. By using dates from wood, much of the confusion disappears. However, because of the scarcity of wood dates, only four of the sixteen identified fluctuations are accurately dated: an advance into Iowa about 14,000 to 13,500 BP, an advance into South Dakota and Iowa about 12,300 BP, an advance into the Lake Michigan basin about 11,700 BP, and an advance into Lake Superior basin about 9900 BP. In addition, the beginning of late Wisconsinan glaciation, before 20,000 BP, is fairly well documented. None of the fluctuations in the western part of the region are accurately dated.

Location : AEU, SCI, QE 696. Q245
AEPAA, Periodicals collection
Areas : Map areas - 72 E, 72 L, 72 M, 73 D, 73 G, 82 NE, 82 SE, 83 SE, Illinois, Iowa, Manitoba - Southern, Minnesota, Montana - Northern, Nebraska, North Dakota, Ontario - Northwestern, Saskatchewan - Southern, South Dakota, Wisconsin
Borden areas - DO, DP, EO, EP, FO, FP, regions as above
Topics : Analysis of radiocarbon dates, Glacial lake sequences, Review of glacial history

Dormaar, J.F.
1976 Palaeosol Studies in Western Canada. In Quaternary Soils, edited by W.C. Mahaney, pp. 209-221. GeoAbstracts, Norwich, England.

While about 120 references refer directly or indirectly to palaeosols in Canada, only about 26 of them are pertinent to the three Prairie Provinces. Geographically, they relate to the Brandon Sand Hills in Manitoba, the Prelate and Saskatoon areas in Saskatchewan, and the Cypress Hills, various river valleys, and regions along the Eastern Slopes of the Rocky Mountains in Alberta. The palaeosols have generally either distinct black or distinct red horizons. Although soil micromorphology is a powerful tool in the study of palaeosols, those of the three Prairie Provinces have been studied with a variety of other methods. Close cooperation between archaeologist, pleistocene geologist, and soil scientist is desirable for further significant contributions to the environmental history of the Prairies.

Location : AEU, SCI, S 592.2. C74 1976
Areas : Map areas - 72 E, 82 G, 82 H, 82 J, 82 N, 82 O, 83 C, 83 F, 83 G, 83 H, Manitoba, Saskatchewan - Southern
Borden areas - DO, DP, EP, EQ, FP, FQ, regions as above
Topics : Review of palaeosol studies, Soil - micromorphology, Tephra - Mazama

Dyke, A.S., and V.K. Prest
1987 Late Wisconsinan and Holocene History of the Laurentide Ice Sheet. Géographie physique et Quaternaire 41:237-263.

Eleven paleogeographic maps and a summary ice retreat map outline the history of advance, retreat, and readvances of the Laurentide Ice Sheet along with associated changes in proglacial drainage and relative sea level oscillations for Late Wisconsinan and Holocene times. The text outlines pertinent chronological control and discusses the paleoglaciology of the ice sheet, with attention to location and migration of ice divides, their attendant domes and saddles, and to ice streams, ice shelves, and mechanisms of deglaciation. At 18 ka the ice sheet consisted of 3 sectors with an interlocked system of ice divides joined at intersector saddles. A throughgoing superdivide is recognized and named the Trans Laurentide Ice Divide. The ice sheet retreated slowly from 18 to 13 ka, mainly along the west and south margins, but still held a near maximum configuration at 13 ka. A regional change in flow pattern over the Prairies just before 14 ka is thought to represent a large reduction in ice volume, but not in extent, and likely was triggered by a switch from nondeforming to deforming bed conditions. Retreat between 13 and 8 ka was vastly more rapid in the west than in the east, which resulted in eastward migration of the divide system of Keewatin Ice but relatively static divides of Labrador and Foxe Ice. By 10 ka the Trans Laurentide Ice Divide had been fragmented as Hudson Ice became increasingly autonomous. By 8 ka Hudson Ice had disappeared, little ice was left in Keewatin, but Foxe Ice still held its near maximum configuration and Labrador Ice was still larger than Foxe Ice. Repeated surging along aquatic margins and calving back of margins thinned by surging probably was the most important mechanism of deglaciation of Keewatin and Hudson Ice. The core of Foxe Ice disintegrated at 7 ka but retreat and readvance of Foxe Ice remnants continued throughout the Holocene.

Location : AEU, PMC, G 1. R452
Areas : Map areas - All Canada except British Columbia
Borden areas - region as above
Topics : Laurentide ice sheet dynamics, Review of glacial chronology

Fenton, M.M.

1984 Quaternary Stratigraphy of the Canadian Prairies. In Quaternary Stratigraphy of Canada - A Canadian Contribution to I.G.C.P. Project 24, edited by R.J. Fulton, pp. 58-68. Geological Survey of Canada Paper 84-10.

Five major Quaternary events on the Canadian Prairies are of early or middle Pleistocene age - PW event, Wellsch Nonglacial Interval, Wascana Nonglacial Interval, Redcliff Nonglacial Interval, and Dunmore Glaciation - and four are of late Pleistocene age - Osler Nonglacial Interval, Burke Lake Glaciation, Watino Nonglacial Interval, and Lostwood Glaciation.

The PW Event during which one or more early Pleistocene Laurentide glaciation(s) occurred that were responsible for transporting south the Precambrian stones found in the nonglacial sediment at Wellsch Valley, was followed by the Wellsch Nonglacial Interval. Both events occurred during the Matuyama Reversed Magnetic Epoch and the nonglacial interval probably occurred at least in part during the Olduvai Event.

The glaciation following the Wellsch Nonglacial Interval possibly was responsible for deposition of one or more tills of the Floral Formation and Sutherland Group. A lack of lithostratigraphic data at the Wellsch Valley site makes correlation between these units tentative.

The Wascana Nonglacial of Aftonian age is about 600±40 ka, based on fission track dating of volcanic ash.

During the Redcliff Nonglacial Interval, which is late Kansan to Yarmouthian, the lower group of sediments in the Medicine Hat area were deposited.

During the Dunmore Glaciation of Illinoian(?) age, two or more tills were deposited in the Medicine Hat area. This was the most extensive glaciation to affect the Prairies with one advance extending to the eastern slopes of the Rocky Mountains in southwestern Alberta.

The Osler Nonglacial Interval of Sangamonian age, Burke Lake Glaciation of Early Wisconsinan age, and Watino Nonglacial Interval of Middle Wisconsinan age have all been recognized at a number of places on the Prairies. Lostwood Glaciation of Late Wisconsinan age followed, resulting in ice covering most of the Prairies.

The chronology for pre-Watino events is derived from correlation with events outside the prairies, fission track age dates, or speculation. The chronology for younger events is based on radiocarbon dates. Watino Nonglacial Interval started before 43.5 ka. and perhaps before 52 ka. and ended after 23.7 ka. The succeeding Lostwood Glaciation reached its maximum between about 20 and 18 ka ago and ice had completely retreated from the Prairies by about 10 ka.

Location : AEU, SCI, QE 185. C2
AEPAA, 557.1 C16P 84-10
ARC, Contribution Series 1159
Areas : Map areas - All Alberta except Mountains and Foothills, Manitoba, Saskatchewan
Borden areas - All Alberta except Mountains and Foothills, regions as above
Topics : Palaeomagnetism, Review of glacial history, Review of Quaternary stratigraphy, Tephra - fission track dating

Fenton, M.M.

1984 Quaternary Events Canadian Prairies: An Example of Correlation of Quaternary Chronologies. In Correlation of Quaternary Chronologies, edited by W.C. Mahaney, pp. 359-369. GeoBooks, Norwich, England.

In the prairies correlation of event units is based upon lithostratigraphic, paleontologic, palynologic, paleomagnetic, and radiocarbon and tephra data. Correlation is accomplished using fragmental data with no section providing all the above types of data. Generally, even complete chronologic and paleoenvironmental information is missing for a particular section.

Integration of many types of data has shown that the Pleistocene record of the Prairies, although still fragmental, is more complete than almost anywhere else in Canada. Five Early or Middle Pleistocene Age events are recognized: the PW Event, the oldest, the Wellsch Valley Nonglacial, the Wascana Nonglacial Interval, the Redcliff Nonglacial and the Dunmore Glaciation. The four Late Pleistocene events are: the Osler Nonglacial Interval (oldest), the Burke Glaciation, the Watino Nonglacial Interval and the Lostwood Glaciation.

Location : AEU, SCI, QE 696. C82 1984
AEPAA, 551.79 Q29
ARC, Contribution Series 1250
Areas : Map areas - All Alberta except Mountains and Foothills, Manitoba, Saskatchewan
Borden areas - All Alberta except Mountains and Foothills, regions as above
Topics : Palaeomagnetism, Review of glacial history, Review of Quaternary stratigraphy, Tephra - fission track dating

Fulton, R.J.

1984 Quaternary Glaciation, Canadian Cordillera. In Quaternary Stratigraphy of Canada - A Canadian Contribution to I.G.C.P. Project 24, edited by R.J. Fulton, pp. 39-47. Geological Survey of Canada Paper 84-10.

Evidence exists for at least four Quaternary glaciations in the Canadian Cordillera.

Other glaciations undoubtedly occurred but these have not yet been stratigraphically documented. During the last major ice advance all of the Cordillera, with the exception of the extreme north and scattered small nunataks, was ice-covered. Little information exists, however, on the extent of ice cover during earlier glaciations.

Evidence is presented for two main nonglacial periods. The oldest appears to have been warmer than present and is correlated with the last main interglaciation (Sangamon-Eemian). The younger period, which occurred between the last two major ice advances, is well-documented and was a time when the climate was almost as warm as that at present. Radiocarbon dating indicates that this event began earlier than the limit of radiocarbon dating and ended by 20-25 ka.

The cooling in advance of the last major ice buildup began at least 25 ka ago, but the Cordilleran Ice Sheet did not reach maximum coverage in Canada until after 17 ka. Ice retreat begun by 13 ka and was nearly complete 3 ka later. It is not possible at present to subdivide the last glaciation into stades and interstades that can be correlated throughout the region.

Early Holocene climate was warm and appears to have not cooled to present levels until after the Hypsithermal. Well documented ice advances occurred between 3 and 2.2 ka ago but in most places the alpine glaciers did not expand to their Holocene maximum positions until the past few centuries.

Location : AEU, SCI, QE 185. C2
AEPAA, 557.1 C16P 84-10
Areas : Map areas - 82 G, 82 H, 82 NE, 83 SW, 83 B, 83 NW, 84 D, Alaska - Eastern, British Columbia, Yukon
Borden areas - DP, EP, EQ, FQ, GQ, regions as above
Topics: Review of glacial history, Review of Quaternary stratigraphy

Fulton, R.J., M.M. Fenton, and N.W. Rutter
1986 Summary of Quaternary Stratigraphy and History, Western Canada. In Quaternary Glaciations in the Northern Hemisphere, edited by V. Sibrava, D.Q. Bowen and G.M. Richmond, pp. 229-241. Report of the International Geological Correlation Programme Project 24, Quaternary Science Reviews, Volume 5. Pergamon Press, Oxford.

Deposits of three Wisconsinan substages (Early, Middle and Late), Sangamonian Stage, Illinoian Stage and older Quaternary stratigraphic units are recognized in Western Canada. The age assignment of these units is based on radiocarbon dating, vertebrate paleontology, paleomagnetic data, and on dating and correlation of tephra.

Quaternary deposits older than Illinoian are probably present in most parts of Western Canada but only in southern Alberta and Saskatchewan is there definite stratigraphic evidence (vertebrate paleontology and paleomagnetic) which permits assigning ages to these units. Here, faunal assemblages with Aftonian, Kansan, and Yarmouthian affinities have been identified in both glacial and nonglacial deposits.

Glacial deposits referred to the Illinoian Stage are present in many parts of the are. The age of these is generally based on stratigraphic position: they underlie nonglacial deposits or a weathering horizon ascribed to the Sangamonian Stage. The most extensive glaciation of the southern Canadian Plains occurred during this stage and it probably was the first time that Laurentide ice reached the Cordillera.

Nonglacial materials of Sangamonian age have been identified in all parts of the area where intensive Quaternary stratigraphic work has been done. The age assignment of these units is in most places based on their warm climate affinities, stratigraphic position below Middle Wisconsinan nonglacial units, content of vertebrate fossils, and presence of organic material older than the limit of radiocarbon dating.

Early Wisconsinan glacial deposits occur in all areas where Sangamonian interglacial and Middle Wisconsinan nonglacial deposits have been recognized. In most other areas they are difficult to separate from older glacial deposits.

There is abundant evidence that the Middle Wisconsinan Substage was primarily a nonglacial period in Western Canada. Recognition of Middle Wisconsinan deposits is primarily based on the presence of organic material, 20-50 ka, dated by the radiocarbon method.

Evidence of cooler climates, heralding Late Wisconsinan glaciation, is locally present as early as 29 ka. The southern Canadian Plains were probably covered by Laurentide ice by 20 ka but the Cordilleran ice was still advancing in southern British Columbia 17.5 ka. The Late Wisconsinan Laurentide ice advance in the southern Plains was not as extensive as the Illinoian or Early Wisconsinan advances. The same appears true of the northern sector of the Cordilleran ice-sheet, but in the southern sector, the limits of Late Wisconsinan and earlier ice sheets lie outside the area covered by this report. The Late Wisconsinan Cordilleran Ice-Sheet was retreating by 13 ka, and by 10 ka glacier cover was little more extensive than at present. The Laurentide Ice-Sheet was retreating before 13.5 ka, had probably receded onto the Shield by 11.5 ka, and had disappeared from Western Canada by 7.3 ka.

Location : AEU, SCI, QE 696. Q245 V5 1986
AEPAA, Periodicals collection
Areas : Map areas - All Alberta, Western Canada
Borden areas - All Alberta, region as above
Topics : Glacial chronology, Review of Quaternary stratigraphy

Fulton, R.J., M.M. Fenton, and N.W. Rutter
1984 Summary of Quaternary Stratigraphy and History. In Quaternary Stratigraphy of Canada - A Canadian Contribution to I.G.C.P. Project 24, edited by R.J. Fulton, pp. 69-83. Geological Survey of Canada Paper 84-10.

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Glacial deposits referred to the Illinoian Stage are present in many parts of the area. The age of these is generally based on stratigraphic position: they underlie nonglacial deposits or a weathering horizon ascribed to the Sangamonian Stage. The most extensive glaciation of the southern Canadian Plains occurred during this stage and it probably was the first time that Laurentide ice reached the Cordillera.

Nonglacial materials of Sangamonian age have been identified in all parts of the area where intensive Quaternary stratigraphic work has been done. The age assignment of these units is in most places based on their warm climate affinities, stratigraphic position below Middle Wisconsinan nonglacial units, content of vertebrate fossils, and presence of organic material older than the limit of radiocarbon dating.

Early Wisconsinan glacial deposits occur in all areas where Sangamonian interglacial and Middle Wisconsinan nonglacial deposits have been recognized. In most other areas they are difficult to separate from older glacial deposits.

There is abundant evidence that the Middle Wisconsin Substage was primarily a nonglacial period in Western Canada. Recognition of Middle Wisconsinan deposits is primarily based on the presence of organic material, 20 to 50 ka, dated by the radiocarbon method.

Evidence of cooler climates, heralding Late Wisconsin glaciation, is locally present as early as 29 ka. The southern Canadian Plains were probably covered by Laurentide ice by 20 ka but the Cordilleran ice was still advancing in southern British Columbia 17.5 ka ago. The Late Wisconsinan Laurentide ice advance in the southern Plains was not as extensive as the Illinoian or Early Wisconsinan advances. The same appears true of the northern sector of the Cordilleran sheet, but in the southern sector, the limits of Late Wisconsinan and earlier ice sheets lie outside the area covered by this report. The Late Wisconsinan and Cordilleran Ice Sheet was retreating by 13 ka, and by 10 ka glacier cover was little more extensive than at present. The Laurentide Ice Sheet was retreating before 13.5 ka, and had probably receded onto the Shield by 11.5 ka, and had disappeared from Western Canada by 7.3 ka.

Location : AEU, SCI, QE 185. C2
AEPAA, 557.1 C16P 84-10
ARC, Contribution Series 1284
Areas : Map areas - All Alberta, Western Canada
Borden areas - All Alberta, region as above
Topics : Review of glacial history, Review of Quaternary stratigraphy

Gravenor, C.P., and L.A. Bayrock
1961 Glacial Deposits of Alberta. In Soils in Canada, edited by R.F. Legget, pp. 33-50. Royal Society of Canada Special Publications No. 3. University of Toronto Press, Toronto.

Abstract : No abstract available
Location : AEU, SCI, S 590. L51 1965
ARC, Contribution Series 151
Areas : Map areas - All Alberta
Borden areas - All Alberta
Topics : Review of Quaternary stratigraphy

Gravenor, C.P., and L.A. Bayrock
1955 Use of Indicators in the Determination of Ice-Movement Directions in Alberta. Geological Society of America Bulletin 66:1325-1328.

Three indicators - Athabasca sandstone, McMurray tar sand, and Presqu'ile dolomite - all demonstrate that the ice-movement direction in central and northern Alberta was southwesterly. Lines drawn from the present location of the indicators to various parts of the original outcrop area give slightly different directions of ice movement; this is especially true of the Athabasca sandstone which has the largest outcrop area of any of the source rocks. In general, however, the ice direction was about S. 20°-35° W.

Abstract : Part of Authors' Conclusions
Location : AEU, SCI, QE 1. G341 V. 66 Part 2 1955
ARC, Contribution Series 51
Areas : Map areas - All Alberta except Mountains and Foothills
Borden areas - All Alberta except Mountains and Foothills
Topics : Erratics, Ice movement indicators

Jackson, Jr., L.E.
1983 Comments on Chronology of Late Wisconsinan Glaciation in Middle North America. *Quaternary Science Reviews* 1:vii-xiv.

Abstract : No abstract available
Location : AEU, SCI, QE 696. Q245
AEPAA, Periodicals collection
Areas : Map areas - 72 E, 72 L, 82 G, 82 H, 82 J, 82 O, 83 F, 83 G, 83 H
Borden areas - DO, DP, EO, EP, FP, FQ
Topics : Analysis of radiocarbon dates, Glacial chronology

Jackson, Jr., L.E., and M. Pawson
1984 *Alberta Radiocarbon Dates: Listings of Radiocarbon Dates with Regional Significance to the Late Quaternary Geochronology and Geomorphology of Alberta*. Geological Survey of Canada Paper 83-25. (27 pp.)

More than five hundred radiocarbon dates from Alberta have been published in the scientific literature and university theses prior to 1982. These dates were produced in the course of geological, archeological, and paleoclimatic investigations. Selected dates from this total are assembled and organized under twelve headings which pertain to Quaternary history and animal life of Alberta. Not all of the paleoclimatic and archeological dates have direct geological significance, nor does published information accompanying these dates always provide adequate stratigraphic information to allow a geological interpretation of them. Consequently, the dates appearing in the accompanying tables include only those for which published information is sufficient to assign regional geological significance rather than merely site-specific value.

Abstract : Part of Authors' Introduction
Location : AEU, SCI, QE 185. C2, No. 83-25
ADTMP, QE 185. G4 P3 83-25
Areas : Map areas - All Alberta
Borden areas - All Alberta
Topics : Analysis of radiocarbon dates

Johnston, W.A.
1933 Quaternary Geology of North America in Relation to the Migration of Man. In *The American Aborigines: Their Origin and Antiquity*, edited by D. Jenness, pp. 11-45. University of Toronto Press, Toronto.

Abstract : No abstract available.
Location : UA, HSS, E 58. J54

Areas : Map areas - All Alberta, All Canada, Beringia
Borden areas - All Alberta, regions as above
Topics : Review of glacial history, Review of migrations

Klassen, R.W.
1983 Chronology of Late Wisconsinan Glaciation in Middle North America - A Discussion. Quaternary Science Reviews 1:xxiii-xxvii.

Abstract : No abstract available
Location : AEU, SCI, QE 696. Q245
AEPAA, Periodicals collection
Areas : Map areas - Manitoba - Southern, Saskatchewan - Southern
Borden areas - regions as above
Topics : Analysis of radiocarbon dates

Luckman, B.H.
1981 The Geomorphology of the Alberta Rocky Mountains: A Review and Commentary. Zeitschrift für Geomorphologie Supplementband 37:91-119.

The available material on the geomorphology of the Alberta Rockies is reviewed with emphasis on the area between Jasper and Lake Louise and work carried out in the past 15 years. The major topics considered include glacial history (Pleistocene and Holocene), karst phenomena, slope development (including rock glaciers and rockslides), permafrost, slow mass movement, fluvial studies and the geomorphic effects of summer storms. Particular attention is given to the landforms and processes of the cliff-talus zone where available dating control suggests debris provision was much greater than present during early Holocene/late Wisconsin time. Therefore an integration of the historical and systematic approaches to the study of landforms in this zone is encouraged. Limited contemporary data indicate that regional sediment yields (suspended plus solutes) from the mountains probably do not exceed 70 B. at the present time. Major gaps in present knowledge of the area are identified and some avenues for future research suggested.

Location : AEU, PMC, G 1. Z48
Areas : Map areas - 82 N, 83 C, 83 D
Borden areas - EQ, FQ
Topics : Review of mountain geomorphology

Moran, S.R., and L. Clayton
1983 Reply to Comments by Jackson. Quaternary Science Reviews 1:xv-xxii.

Abstract : No abstract available
Location : AEU, SCI, QE 696. Q245
AEPAA, Periodicals collection
Areas : Map areas - 82 NE
Borden areas - EP
Topics : Analysis of radiocarbon dates, Glacial chronology

Moran, S.R., L. Clayton, R. LeB. Hooke, M.M. Fenton, and L.D. Andriashek
1980 Glacier-bed Landforms of the Prairie Region of North America. Journal of Glaciology 25:457-476.

Two major types of terrain that formed at or near the bed of Pleistocene continental ice sheets are widespread throughout the prairie region of Canada and the United States. These are (1) glacial-thrust blocks and source depressions, and (2) streamlined terrain.

Glacial-thrust terrain formed where the glacier was frozen to the substrate to a value less than that applied by the glacier. The marginal zone of ice sheets consisted of a frozen-bed zone, no more than 2-3 km wide in places, within which glacial-thrust blocks are large and angular. Up-glacier from this zone, the thrust blocks are generally smaller and smoothed. Streamlined terrain begins 2-3 km behind known ice-margin positions and extends tens of kilometres up-glacier. Streamlined terrain formed in two ways: (1) erosion of the substrate as a consequence of basal sliding in the sub-marginal thawed-bed zone, and (2) erosional smoothing accompanied by emplacement of till in the lee of thrust blocks where they were deposited and subsequently exposed to thawed-bed conditions as a result of further advance of the glacier.

Location : AEU, SCI, QE 575. J86
ARC, Contribution Series No. 1186
Areas : Map areas - All Alberta, Saskatchewan, Manitoba
Borden areas - All Alberta, regions as above
Topics : Glacial geomorphology - glacial thrust terrain, Glacial geomorphology - streamlined terrain

Odynsky, W.
1958 U-Shaped Dunes and Effective Wind Directions in Alberta. Canadian Journal of Soil Science 38:56-62.

Studies were made of aerial photographs of sand dune areas outlined by the Alberta Soil Survey. The presence of U-shaped, V-shaped, blow-out parabolic dunes indicated the direction of the effective wind responsible for their formation. Descriptions, pictures of such dunes and a sketch map showing the probable effective wind directions are included in the report. The shapes of these dunes indicate that the effective wind direction in the Grande Prairie area was from the southwest. In the central portion of Alberta the effective wind direction was from the northwest, while in the southern and southeastern portion of the province the effective winds were from the southwest. Comparison of the indicated effective wind directions with the average pattern of the direction of strong winds shows a very marked similarity.

Location : AEU, SCI, S 590. C21
ARC, Contribution Series No. 62
Areas : Map areas - All Alberta
Borden areas - All Alberta
Topics : Geomorphology - dunes, Palaeowind direction

Pawluk, S., and L.A. Bayrock

1969 Some Characteristics and Physical Properties of Alberta Tills. Research Council of Alberta Bulletin 26. (72 pp.)

Maps depicting the regional variation in the chemical and mineralogical composition, and physical properties of tills from throughout the plains region of Alberta were prepared by a computer with an attached plotter.

The chemical constituents and properties analyzed and discussed are: copper, zinc, manganese, calcium, boron, molybdenum, cobalt, pH, and soluble salts The mineralogical components included are clay minerals and feldspars. The physical properties included are particle-size distribution, liquid limit and plastic limit, on the basis of which a number of additional engineering properties were calculated and discussed: plasticity number, plasticity, activity and corrosion potential.

Generally, the lithology of the till closely reflects that of the underlying bedrock. A noticeable exception is the distribution of soluble salts, the origin of which is more likely related to groundwater phenomena.

Location : AEU, SCI, QE 186. R415 No. 026
ARC, Bulletin 26
Areas : Map areas - All Alberta
Borden areas - All Alberta
Topics : Till - chemical composition, Till - physical properties, Till - lithology, Till - trace elements

Reeves, B.

1971 On the Coalescence of the Laurentide and Cordilleran Ice Sheets in the Western Interior of North America with Particular Reference to the Southern Alberta Area. In Aboriginal Man and Environments on the Plateau of Northwest America, edited by A.H. Stryd and R.A. Smith, pp. 205-228. The Students' Press, Calgary.

To conclude, if we must look for environmental mechanisms to control the movement of human populations to and within the New World, I would suggest that the ice sheets should no longer be invoked as the Prime Causal Agent. They did not, in Late Pleistocene times, coalesce to form a fifteen hundred mile, two thousand foot thick barrier of solid ice. At worst, in the last one hundred thousand years or so, this so-called barrier probably consisted of the coalescence for a small interval of time, of a few mountain piedmont lobes with the Laurentide ice sheet. Large ice and water free areas which physiographically presented no barrier to human movement were present. Whether the environment (at this time of maximum advance) was suitable to support viable biotic populations, particularly in the high latitude areas such as the Mackenzie Mountains, is another matter entirely.

Abstract : Author's Conclusions
Location : AEPAA, 970. 41205 UN3
Areas : Map areas - All Alberta, British Columbia - Northeastern, Saskatchewan - Southern, Yukon
Borden areas - All Alberta, regions as above
Topics : Archaeology - human population movement, Ice-free corridor, Review of glacial history

Reeves, B.O.K.

1983 Bergs, Barriers and Beringia: Reflections on the Peopling of the New World. In Quaternary Coastlines and Marine Archaeology: Towards the Prehistory of Land Bridges and Continental Shelves, edited by P.M. Masters and N.C. Flemming, pp. 389-411. Academic Press, New York.

The debate on the time and entry of Early People into the New World generally focuses on the nature and extent of Western Canadian Ice Free Corridors - coastal, Cordilleran and interior - as the controlling mechanisms. The Late Wisconsin (ca. 20,000-14,000) glaciation was limited, in extent, and while the Cordillera was covered by an ice-dome, both coastal and interior routes were open. A 100-200 km wide corridor existed at the height of glaciation, from the unglaciated regions of the Central Yukon south along the entire western border of the interior plains and foothills to the unglaciated regions of the continental interior of the United States.

Rocky Mountain glaciers were very limited in extent, and did not advance beyond the mountain fronts. The corridor's environment appears to have been characterized throughout by a cold, dry steppe tundra capable of supporting Rancholabrean grazers and man. Man was present by this time in both Eastern Beringia and the unglaciated regions to the south, which indicates that man could have entered during Mid-Wisconsin (54,000-20,000) and/or earlier non-glacial times - the Sangamon (ca. 120,000 years ago). Ice distributions and environments in Western Canada were at these times analogous to today's, and more than sufficient time was available to populate the entire Western Hemisphere by people resident in Eastern Beringia throughout the time period.

Location : AEU, HSS, GN 741. Q22 1983
Areas : Map areas - All Alberta, British Columbia - Elk Valley, British Columbia - Northeastern, Northwest Territories - Western, Saskatchewan, Yukon
Borden areas - All Alberta, regions as above
Topics : Analysis of radiocarbon dates, Archaeology - human population movement, Ice-free corridor, Review of glacial history, Review of palaeoenvironmental studies

Reeves, B.O.K.

1973 The Nature and Age of the Contact Between the Laurentide and Cordilleran Ice Sheets in the Western Interior of North America. Arctic and Alpine Research 5:1-16.

The presumed existence of a single mass of coalesced Cordilleran and Laurentide ice during most of late Wisconsin time is central to many archaeological hypotheses on the peopling of the New World. The area under concern is a 2,400-km belt of the Western Interior Plains and adjacent mountains, extending from the 49th parallel to the Arctic Ocean. Multiple Cordilleran glaciation occurred in the Rocky Mountain area during both late and early Wisconsin time. Radiocarbon dates indicate the mountain valleys were largely ice-free by 10,500 BP. Multiple Laurentide glaciation also is well established, the last advances in southern Alberta (late Wisconsin) having terminated east of the mountain front. Southern Alberta and southwestern Saskatchewan were ice-free by ca. 15,000 BP. Incontrovertible evidence for coalescence west of the late Wisconsin ice front comes only from the Athabasca Valley, where Roed found that the two glaciers coalesced and flowed southeast. This event occurred either in early Wisconsin or Illinoian time. Since then the western border of the plains of Alberta has remained ice-free.

Location : AEU, SCI, G 1. A68
Areas : Map areas - All Alberta, British Columbia - Northeastern, Saskatchewan, Yukon
Borden areas - All Alberta, regions as above
Topics : Archaeology - human population movement, Ice-free corridor, Review of glacial history

Rutter, N.W.
1984 Pleistocene History of the Western Canadian Ice-free Corridor. In Quaternary Stratigraphy of Canada - A Canadian Contribution to I.G.C.P. Project 24, edited by R.J. Fulton, pp. 49-56. Geological Survey of Canada Paper 84-10.

The ice-free corridor is a belt of land that was largely ice free during maximum Pleistocene glaciations and that extended northward from about the Canada-United States border, east of the Rocky, Mackenzie, and Richardson mountains between Cordilleran and Laurentide glaciers. The most complete record is for Wisconsinan-age events. Although other interpretations have merit, it appears that early Wisconsinan glaciers flowed out of the mountains, coalescing with westward flowing Laurentide glaciers, at least in southwestern Alberta. In Yukon Territory and Northwest Territories, Cordilleran ice was restricted and confined within mountain valleys whereas Laurentide glaciers reached the mountain front. No Middle Wisconsinan glacier activity is recorded. During Late Wisconsinan time Laurentide glaciers advanced as far west as Lethbridge, Calgary, and Edson in southern Alberta, whereas Cordilleran glaciers terminated near the mountain front or within the major valleys. Therefore, an ice-free corridor was present from about the International Boundary to the Jasper-Hinton area. In northeastern British Columbia, Cordilleran glaciers flowed beyond the mountain front and coalesced with Laurentide ice advancing from the east. In Yukon Territory and Northwest Territories, Laurentide glaciers penetrated the Mackenzie and Richardson mountains but Cordilleran ice did not advance far down the mountain valleys, resulting in an ice-free corridor in this region.

Location : AEU, SCI, QE 185. C2
AEPAA, 557.1 C16P 84-10
Areas : Map areas - 72 E, 72 L, 82 G, 82 H, 82 N, 82 NE, 83 B, 83 G, 83 J, 83 NW, 83 SW, 84 C, 84 D, British Columbia - Northeastern
Borden areas - DO, DP, EP, EQ, FP, FQ, GP, GQ, HQ, regions as above
Topics : Ice-free corridor, Review of glacial history

Rutter, N.W.
1981 Late Pleistocene Ice Limits in Western Canada. In Alberta Archaeology: Prospect and Retrospect, edited by T.A. Moore, pp. 21-29. The Archaeology Society of Alberta, Lethbridge.

Abstract : No abstract available
Location : AEPAA, 917.12303 AL14
ADTMP, E 78. A34 AL14
Areas : Map areas - 72 E, 72 L, 82 G, 82 H, 82 N, 82 NE, 83 B, 83 G, 83 J, 83 NW, 83 SW, 84 C, 84 D, British Columbia - Northeastern
Borden areas - DO, DP, EP, EQ, FP, FQ, GP, GQ, HQ, regions as above

Topics: Ice-free corridor, Review of glacial history

Rutter, N.W.
1980 Late Pleistocene History of the Western Canadian Ice-free Corridor. Canadian Journal of Anthropology 1:1-7.

Recent investigations of the relationship between Pleistocene Cordilleran and Laurentide glaciers suggest that the ice-free corridor was closed for a relatively short period during the Wisconsin Glaciation. The corridor could have been closed sometime during Early Wisconsin (approximately 100,000-120,000 to approximately 50-70,000 years B.P.) although little is known about glacial events during this period. It was most likely open during the Middle Wisconsin. During Late Wisconsin time (approximately 10,000 to 25,000 years B.P.) the corridor was probably open from about the U.S.-Canadian border to the Jasper-Edmonton area, closed for a period from the Jasper-Edmonton area northward to the B.C.-Alberta border and open beyond to the Arctic Ocean. Man could have migrated freely in this region during most of the Wisconsin.

Location: AEU, PMC, GN 1. C22
AEPAA, Periodicals collection
Areas: Map areas - 72 E, 72 L, 82 G, 82 H, 82 N, 82 NE, 83 B, 83 G, 83 J, 83 NW, 83 SW, 84 C, 84 D, British Columbia - Northeastern
Borden areas - DO, DP, EP, EQ, FP, FQ, GP, GQ, HQ, regions as above
Topics: Ice-free corridor, Review of glacial history

Rutter, N.W.
1969 Pleistocene Paleosol Investigations in Parts of Western Canada. In Pedology and Quaternary Research, edited by S. Pawluk, pp. 83-102. National Research Council of Canada.

Very few Pleistocene paleosols have been described in Western Canada and these are confined mostly to buried soils. Three areas are discussed that offer promise for relict paleosol study at the present time - the Interior Plains, the Rocky Mountains and environs, and parts of the Yukon. Reconstructions of past geomorphology, climate and vegetation may be aided by comparing soils on different surfaces and by individual study.

In the Interior Plains, stillstands and readvances of the last glaciation may be detected by recording differences in weathering intensity and profile thicknesses of soil in till on either side of a former ice front position. In the southern Rocky Mountains and environs three surfaces of widely varying age are present - at lower elevations, Wisconsin; at intermediate elevations, pre-Wisconsin (?); and at higher elevations, unglaciated surfaces. By relict soil study it may be possible to confirm that the pre-Wisconsin (?) surface actually represents an interglacial interval. In parts of the Yukon, at least four distinct surfaces are present. These include a non-glacial surface, at least Miocene age; a high terrace, whose surface dates from pre-Illinoian time; and lower terraces, dating from early Wisconsin or Illinoian and late Wisconsin times. The presence of ancient surfaces at varying elevations permits detailed study of the complexities and inter-relationships of soil development and geomorphic evolution.

Location: AEU, SCI, S 590. P37
AEPAA, 551.79 P342

Areas : Map areas - All Alberta, Manitoba, Saskatchewan, Yukon
Borden areas - All Alberta, regions as above
Topics : Review of palaeosol studies, Glacial chronology, Unglaciated terrain

Stalker, A. MacS.
1968 Identification of Saskatchewan Gravels and Sands. Canadian Journal of Earth Sciences 5:155-163.

"Saskatchewan gravels and sands" is the name used for numerous, widely scattered deposits of gravel and sand found on the Canadian Prairies. These deposits represent the final phase of deposition by preglacial rivers before the first Pleistocene ice-sheet disrupted regional drainage. In the past, Saskatchewan gravels and sands have been identified chiefly by their absence of stones from the Canadian Shield and position below the drift in buried valleys or on low ground. These remain the basic criteria. Sole dependence on them, however, has resulted in extraneous deposits being called Saskatchewan. Such misidentifications cannot be eliminated entirely, but their number can be greatly decreased by use of additional checks. These include intensive study of each deposit and its topographic position, and establishing that there was both an adequate source for the gravel and sand contained in it and competent means of transporting that material from source to present site. In addition, the valley containing the deposit must have formed an integral part of the preglacial drainage system; its cross-section and longitudinal profile must have resembled those of a typical preglacial valley, and there must not have been any competing valley that could have carried the local, preglacial drainage more efficiently.

Location : AEU, SCI, QE 1. C212
AEPAA and ADTMP, Periodicals collection
Areas : Map areas - 72 E, 72 L, 82 G, 82 H, 82 NE, 83 SE, 83 I, 83 J
Borden areas - DO, DP, EO, EP, FP, GP
Topics : Quaternary stratigraphy - Saskatchewan gravels and sands

Stalker, A. MacS.
1961 Buried Valleys in Central and Southern Alberta. Geological Survey of Canada Paper 60-32. (13 pp.)

Abstract : No abstract available
Location : AEU, SCI, QE 185. C2
Areas : Map areas - 72 E, 72 L, 82 G, 82 H, 82 NE, 83 SE, 83 I, 83 J
Borden areas - DO, DP, EO, EP, FP, GP
Topics : Buried valleys, Drainage systems

Westgate, J.A.
1968 Linear Sole Markings in Pleistocene Till. Geological Magazine 105:501-505.

Current-produced sole markings are not uncommon in the Pleistocene continental till deposits of Alberta, Canada. Groove, striation and prod molds have all been recognized, characteristically occurring in close association on the undersurface of the till beds. These sedimentary structures provide a rapid means by which local ice-flow directions may be determined.

Location : AEU, SCI, QE 1. G34
Areas : Map areas - 72 E, 83 H, 84 C
Borden areas - DO, FP, HQ
Topics : Ice movement indicators, Till - structures

b. Southern Western Corridor

Alley, N.F.

1973 Glacial Stratigraphy and the Limits of the Rocky Mountain and Laurentide Ice Sheets in Southwestern Alberta, Canada. Bulletin of Canadian Petroleum Geology 21:153-177.

The Quaternary deposits occurring in part of southwestern Alberta were investigated to determine the sequence of glacial events and the synchroneity and direction of movement of the Rocky Mountain and Laurentide ice masses. In this area there is evidence of three major glacial episodes of decreasing magnitude (an episode consisting of one Mountain and one Laurentide advance). During each episode, the Mountain glaciers reached their maxima and receded considerably before the advance of the Laurentide ice. One other less extensive advance, subsequent to the last major glacial episode, occurred in the Mountains.

Tills deposited by advances of Mountain ice, named in order of decreasing age, are the Albertan, Maycroft, Ernst and Hidden Creek tills. In accordance with the stratigraphy of Stalker (1963) the Laurentide tills are referred to as the Labuma, Maunsell and Buffalo Lake tills. The Saskatchewan Sands and Gravels underlie the Albertan Till in the Foothills and the Labuma Till on the Plains.

Stratigraphic, radiocarbon and palynologic evidence suggest that the three major glacial advances are pre-Classical Wisconsin in age whereas the Hidden Creek advance is Classical Wisconsin.

Location : AEU, SCI, TN 860. A32
AEPAA and ADTMP, Periodicals collection
Areas : Map areas - 82 G, 82 H, 82 I, 82 J
Borden areas - DP, EP
Topics : Glacial chronology, Quaternary stratigraphy

Alley, N.F., and S.A. Harris

1974 Pleistocene Glacial Lake Sequences in the Foothills, Southwestern Alberta. Canadian Journal of Earth Sciences 11:1220-1235.

Three separate advances of Laurentide ice during the preWisconsin and Early Wisconsin led to the formation of proglacial lakes in the Foothills of southwestern Alberta. Lakes formed in both the advance and recessional stages, the most extensive occurring during the latter. Evidence of lakes formed by the first advance is fragmentary, but for the later advances, the occurrence of extensive glaciolacustrine deposits and related features attests to the presence of former large bodies of water. Two lakes (Glacial Lakes Oldman and Westrup) resulted from the second advance of Laurentide ice into the Foothills. Damming of Cordilleran meltwaters by the third (Early Wisconsin) Laurentide ice sheet to affect the area, led to the formation of Glacial Lake Caldwell and the development of complex flights of valley train terraces along the Oldman and Crowsnest River valleys.

The relationship of the proglacial lakes to the ice fronts substantiates the stratigraphic evidence that the Cordilleran and Laurentide ice-maxima during each advance were not synchronous and that the valley glaciers had receded considerably before the Continental ice sheet advanced into the Foothills of southwestern Alberta.

Location : AEU, SCI, QE 1. C212
AEPAA and ADTMP, Periodicals collection

Areas : Map areas - 82 G, 82 H, 82 I, 82 J
Borden areas - DP, EP
Topics : Glacial chronology, Glacial lake sequences

Barendregt, R.W.
1984 Correlation of Quaternary Chronologies Using Paleomagnetism -Examples from Southern Alberta and Saskatchewan. In Correlation of Quaternary Chronologies, edited by W.C. Mahaney, pp. 59-71. GeoBooks, Norwich, England.

The paleomagnetic characterization of fine-grained deposits found in southern Alberta and Saskatchewan has yielded valuable data for correlation and dating purposes. Samples collected at Wellsch Valley, Saskatchewan, Galt Island, Alberta, Kipp, Alberta, and Longview, Alberta have provided records of the earth's paleofield in the form of reversals, excursions and secular variation which have allowed correlation with events of the established magnetic time scale for the Quaternary.

Location : AEU, SCI, QE 696. C82 1984
AEPAA, 551.79 Q29
Areas : Map areas - 72 L, 82 H, 82 J, Saskatchewan - Wellsch Valley
Borden areas - DP, EP, EO, regions as above
Topics : Palaeomagnetism

Barendregt, R.W., C.S. Churcher, and A. MacS. Stalker
1988 Stratigraphy, Paleomagnetism, and Vertebrate Paleontology of Quaternary Preglacial Sediments at the Maser-Frisch Site, Southeastern Alberta. Geological Society of America Bulletin 100:1824-1832.

This paper presents the results of a combined stratigraphical, paleomagnetic, and vertebrate paleontological study of the Maser-Frisch Site near Irvine, Alberta. At that site, about 3 m of mainly pond and stream deposit, overlies Cretaceous bedrock and underlies Quaternary till and loess. All of the deposits have normal magnetic polarity. Further, the lower pond and stream deposits have yielded an interesting collection of mammal bones. Taxa identified include rabbit or hare, ground squirrel, prairie dog, bog lemming, canids, cats, badger, elephant, horses, camel, and shrub-ox.

The identified taxa tentatively imply a late Irvingtonian Land Mammal Age for the fauna. This, along with their preglacial setting and normal polarity, indicates that the pond and stream deposits were laid down near the beginning of the Brunhes Polarity Chron (about 0.7 Ma) and so provide a maximum limit for the first glaciation of the region. Together, the fauna and deposits offer an interesting glimpse at conditions prevailing on the High Plains of the region at that time, which apparently resembled the dry, treeless grassland found there at present.

Location : AEU, SCI, QE 1. G341
Areas : Map areas -72 E, Saskatchewan - Wellsch Valley
Borden areas -DO, region as above
Topics : Faunal remains, Palaeomagnetism, Quaternary stratigraphy

Bayrock, L.A., and J.F. Jones

1963 Surficial Geology of the Vauxhall District, Alberta. Research Council of Alberta Preliminary Report 63-2. (4 pp.)

The surficial deposits of the Vauxhall district consist predominantly of till, mainly in the form of ground moraine. Approximately one-third of the map area is covered by glaciolacustrine materials, mostly consisting of thin loam and silty loam deposits. Sandy and gravelly alluvium is present in the Bow River valley, and aeolian sand is found in the southwest part of the area.

Location : AEU, SCI, QE 186. P7 No. 63-002
ARC, Earth Science Report 63-2
Areas : Map areas - 82 I
Borden areas - EP
Topics : Quaternary stratigraphy

Beaty, C.B.

1975 Coulee Alignment and the Wind in Southern Alberta, Canada. Geological Society of America Bulletin 86:119-128.

Study of the distinctive pattern of alignment and geographical distribution of more than 250 coulees in the plains of southern Alberta shows that (1) the coulees in question have a mean orientation of N. 70° E., and (2) their spatial distribution is not ubiquitous but rather displays a concentration in the area from Lethbridge west to the Rocky Mountain front.

Several possible hypotheses of origin of the aligned coulees are considered, including subsurface structural control, the role of regional slope, the effect of lithologic differences, and wind action.

Action of postglacial wind, operating to initiate surface furrows (by wind-driven snow or rain) that were enlarged by running water, accounts for the three outstanding characteristics of the aligned coulees: (1) their preferred orientation of N. 70° E., which approximates the mean direction of the strongest chinook winds in the southern Alberta plains; (2) their geographical distribution, which coincides with that part of the region experiencing the most pronounced chinooks; and (3) their almost exclusive location on windward topographic surfaces. No other hypothesis of origin is known that can satisfactorily explain all of these observed facts.

Location : AEU, SCI, QE 1. G341
AEPAA, Periodicals collection
Areas : Map areas - 72 E, 72 L, 82 G, 82 H, 82 I
Borden areas - DO, DP, EO, EP
Topics : Geomorphology - coulee alignment, Palaeowind direction

Clague, J.J.

1982 Minimum Age of Deglaciation of Upper Elk Valley, British Columbia: Discussion. Canadian Journal of Earth Sciences 19:1099-1100.

Abstract : No abstract available
Location : AEU, SCI, QE 1. C212
AEPAA and ADTMP, Periodicals collection

Areas : Map areas - 82 J, British Columbia - Elk Valley
Borden areas - EP, region as above
Topics : Analysis of radiocarbon dates

Dormaar, J.F., and L.E. Lutwick
1969 Infrared Spectra of Humic Acids and Opal Phytoliths as Indicators of Palaeosols. *Canadian Journal of Soil Science* 49:29-37.

Palaeosols may be found in almost every stream valley in southern Alberta. Humic acids from Ah horizons of palaeosols from five locations were examined by infrared spectroscopy, and the percentage of opal phytoliths in the coarse silt (20 to 50μ) fraction was determined.

The combination of the character of the infrared spectra of humic acids and opal phytolith counts was helpful in explaining the genesis of the palaeosols of the five locations. Sometimes the presence or absence of evidence of human occupation will add to the interpretation. In the locations examined, grasslands apparently have been dominant during post-glacial times with invasions of trees, such as *Populus* spp. and *Salix* spp., in the moister and more sheltered riparian habitats in this area. Any of these invasions naturally led to a transformation of these grassland soils.

Location : AEU, SCI, S 590. C21 V. 48-49 1968-69
Areas : Map areas - 82 G, 82 H
Borden areas - DP
Topics : Archaeological sites - DiPj-3, Archaeological sites - DjPk-1, Archaeological sites - DlPk-3, Opal phytoliths, Palaeosols, Soil - chemical properties, Soil - pedogenesis, Soil - physical properties, Tephra - Mazama

Farvolden, R.N.
1969 Bedrock Channels of Southern Alberta. In *Geomorphology: Selected Readings*, edited by J.G. Nelson and M.J. Chambers, pp. 243-255. Process and Method in Canadian Geography, Methuen, Toronto.

Abstract : No abstract available
Location : AE, 551.4 NEL
Areas : Map areas - 72 E, 72 L, 72 M, 73 D, 73 E, 73 L, 82 G, 82 H, 82 NE, 83 I, 83 J, 83 SE
Borden areas - DO, DP, EO, EP, FO, FP, GO, GP
Topics : Bedrock channels

Farvolden, R.N.
1963 Bedrock Channels of Southern Alberta. In *Early Contributions to the Groundwater Hydrology of Alberta*, edited by R.N. Farvolden, W.A. Meneley, E.G. Le Breton, D.H. Lennox and P. Meyboom, pp. 63-75. Research Council of Alberta Bulletin 12.

Abstract: No abstract available
Location : AEU, SCI, QE 186. R415 No. 012
ARC, Bulletin 12
Areas : Map areas - 72 E, 72 L, 72 M, 73 D, 73 E, 82 H, 82 NE, 83 SE

Borden areas - DO, DP, EO, EP, FO, FP
Topics : Bedrock channels

Ferguson, A., and G. Osborn
1982 Minimum Age of Deglaciation of Upper Elk Valley, British Columbia: Reply. Canadian Journal of Earth Sciences 19:1100.

Abstract : No abstract available
Location : AEU, SCI, QE 1. C212
AEPAA and ADTMP, Periodicals collection
Areas : Map areas - 82 J, British Columbia - Elk Valley
Borden areas - EP, region as above
Topics : Analysis of radiocarbon dates

Ferguson, A., and G. Osborn
1981 Minimum Age of Deglaciation of Upper Elk Valley, British Columbia. Canadian Journal of Earth Sciences 18:1635-1636.

Bog sediments at an elevation of 1582 m in the upper Elk Valley of British Columbia were dated at three horizons. The lowermost of these, radiocarbon dated at 13 430±450 years BP, provides a minimum age for deglaciation of Elk Valley. This date is probably also a minimum for the Canmore advance in the Bow Valley, Alberta, and suggests that the Canmore was not related to deposition of the Bighill Creek Formation at Cochrane. Pollen samples from the bog indicate a shrub-herb pioneer assemblage following deglaciation of that portion of the valley.

Location : AEU, SCI, QE 1. C212
AEPAA and ADTMP, Periodicals collection
Areas : Map areas - 82 J, British Columbia - Elk Valley
Borden areas - EP, region as above
Topics : Analysis of radiocarbon dates, Glacial chronology, Pollen analysis

George, H., W.A. Gorman, and D.F. VanDine
1987 Late Quaternary Geology and Geomorphology of the Elk Valley, Southeastern British Columbia. Canadian Journal of Earth Sciences 24:741-751.

Glacial stratigraphy and geomorphology of the bottom areas of the Elk Valley support the existence of one major ice advance, presumably during the late Wisconsinan. Its retreat probably occurred in two stages by orderly frontal withdrawal. Glacial Lake Elk, formed within the Elk Valley from meltwaters released by this glacier, was dammed initially by an ice plug from the Rocky Mountain Trench glacier at a point near Morissey and subsequently less than 3 km upvalley from Elko. The lake drained in at least three stages.

Location : AEU, SCI, QE 1. C212
AEPAA and ADTMP, Periodicals collection
Areas : Map areas - 82 G, 82 J, British Columbia - Elk Valley
Borden areas - DP, EP, region as above
Topics : Glacial chronology, Glacial geomorphology, Glacial lake sequences

Gravenor, C.P., and L.A. Bayrock

1956 Use of Indicators in the Determination of Ice-Movement Directions in Alberta, Canada: A Reply. Geological Society of America Bulletin 67:1105-1110.

Abstract : No abstract available
Location : AEU, SCI, QE 1. G341 V67 Part 2
Areas : Map areas - 72 G, 72 L, 72 M, 73 D, 73 E, 82 G, 82 H, 82 NE, 83 SE, Montana - Northern, Saskatchewan - Southern
Borden areas - DO, DP, EO, EP, FO, FP, region as above
Topics : Glacial geomorphology, Ice movement indicators

Harris, S.A., and R.R. Waters

1977 Late Quaternary History of Southwest Alberta: A Progress Report. Bulletin of Canadian Petroleum Geology 25:35-62.

Recent mapping confirms the threefold division of the glacial record in the area postulated earlier by Warren (1954) and Stalker (1960). Evidence for a fourth early glaciation has been found only in the South Nahanni National Park (Ford, 1975), in contrast to the three pre - Bull Lake events reported from Glacier National Park, immediately to the south of Alberta (Richmond, 1965b).

The oldest relatively widespread tills are the Albertan till from the Rocky Mountains and the Labuma till from the Laurentian Shield area. They appear to be Illinoian or earlier in age. They were followed by strong weathering and considerable erosion, together with deposition of the Tofield sands. The next glacial event produced extensive piedmont lobes of Rocky Mountain ice (the Maycroft glaciation) followed closely by the Maunsell ice from the east. Deposits of this age are particularly well preserved in the area south of Nanton. Meltwater formed extensive proglacial lakes which drained southward. This glaciation appears to have been Illinoian or early Wisconsinan in age, and was followed by a nonglacial event during which the Strathcona sands and silts may partly have been formed.

The final event was Late Wisconsinan and consisted of the more limited Bow Valley glaciation, forming large prominent lobes near the main present-day centres of cirque glaciation, and the Lochend ice advance from Hudson Bay. At least five subdivisions of the Bow Valley glaciation have been postulated, and ice did not retreat to the present position until about 8000 years B.P. in the Banff-Jasper National Parks (Harris and Howell, 1976) and 7000 years B.P. in South Nahanni Park (Ford, 1975; 1976). The Altithermal period may have finally produced the rapid ice retreat. The Buffalo Lake ice stagnated in many areas, persisting locally until 9600 years B.P. (Boydell, 1972). The most extensive Neoglacial event appears to have been the last (Luckman, 1975).

Location : AEU, SCI, TN 860. A32
AEPAA and ADTMP, Periodicals collection
Areas : Map areas - 82 G, 82 H, 82 I, 82 J, 82 O
Borden areas - DP, EP
Topics : Glacial chronology, Glacial lake sequences, Neoglaciation, Review of glacial history

Harrison, J.E.

1976 Evolution of a Landscape: the Quaternary Period in Waterton Lakes National Park. Geological Survey of Canada Miscellaneous Report 26. (33 pp.)

Abstract : No abstract available
Location : AEU, SCI, QE 186. H32 1976
Areas : Map areas - 82 G, 82 H
Borden areas - DP
Topics : Glacial chronology, Glacial geomorphology

Horberg, L.

1954 Rocky Mountain and Continental Pleistocene Deposits in the Waterton Region, Alberta, Canada. Geological Society of America Bulletin 65:1093-1150.

Continental drift of probable Cary age overlies Early Wisconsin and Late Wisconsin mountain drift in the Rocky Mountain piedmont of the Waterton region, Alberta, Canada. On the basis of geomorphic relations and soil profiles the Early Wisconsin moraines are correlated with the Iowan and Tazewell, and the Late Wisconsin moraines with the Cary. An older, deeply weathered drift (Kennedy drift) on remnants of the high-level Flaxville erosion surface is correlated with the Kansan. There are marked differences in the profiles of weathering developed on drifts correlated with the Kansan, Iowan-Tazewell, and Cary. A buried soil, named the Drywood soil, which occurs on Early Wisconsin mountain drift below the continental drift, is tentatively correlated with the Brady soil of the Middle West.

A series of proglacial lakes, formed as the continental ice withdrew down drainage, are reconstructed on the basis of shoreline features and outlet channels.

Periglacial features are represented by natural mounds and involuted zones.

Postglacial deposits include: (1) colluvium and a volcanic ash layer assigned to the Xerothermic period, and (2) cirque moraine, gravel fans and valley gravels, and a buried peat bed assigned to the Little Ice Age. The peat bed has a radiocarbon age of 3261±250 - 3327±320 years.

In general the Pleistocene record suggests that glacial maxima in the mountains were essentially synchronous with the Kansan, Iowan-Tazewell, and Cary maxima of the Keewatin ice sheet in the western part of the continental interior.

Location : AEU, SCI, QE 1. G341
AEPAA, Periodicals collection
Areas : Map areas - 82 G, 82 H, Montana - Glacier National Park
Borden areas - DP, region as above
Topics : Glacial chronology, Glacial lake sequences, Neoglaciation, Palaeosols, Periglacial geomorphology, Quaternary stratigraphy, Tephra - presumed Glacier Peak

Horberg, L.

1952 Pleistocene Drift Sheets in the Lethbridge Region, Alberta, Canada. Journal of Geology 60:303-330.

Three Pleistocene drift sheets exposed along the Oldman River Valley in southern Alberta are correlated tentatively with the Iowan and the Tazewell or Cary substages of the Wisconsin glacial stage. The "interglacial" beds of previous writers (here named the "Lenzie silt") are considered to be proglacial lake beds deposited in front of the retreating Tazewell or Cary ice sheet. An important retreat and readvance of the ice to the position of the Lethbridge moraine is evidenced within the area. The Saskatchewan gravels, which underlie the drift sheets, are believed to be nonglacial in origin and probably preglacial in age. As such they cannot represent a pre-Kansas "Albertan" stage of glaciation, as was proposed by Dawson.

Location : AEU, SCI, QE 1. J8
AEPAA, Periodicals collection
Areas : Map areas - 72 E, 82 H
Borden areas - DO, DP
Topics : Glacial chronology, Glacial lake sequences, Quaternary stratigraphy, Quaternary stratigraphy - Saskatchewan gravels and sands, Tephra - presumed Glacier Peak

Horberg, L., and R.A. Robie
1955 Postglacial Volcanic Ashes in the Rocky Mountains, Montana and Alberta. Geological Society of America Bulletin 66:949-956.

A volcanic ash layer, which occurs in postglacial alluvium and colluvium at several localities in southern Alberta and northwestern Montana, is named the Galata ash. The stratigraphic relations and physical properties of the ash indicate a single episode of volcanic activity and possible correlation with an ash layer in southwestern Glacier Park assigned on the basis of pollen analyses to the postglacial Xerothermic period.

Location : AEU, SCI, QE 1. G341
Areas : Map areas -82 H, Montana - Northern
Borden areas -DP, region as above
Topics : Tephra - "Galata", Tephra - glass shard morphology, Tephra - Mazama, Tephra - mineralogy

Jackson, Jr., L.E.
1980 Glacial History and Stratigraphy of the Alberta Portion of the Kananaskis Lakes Map Area. Canadian Journal of Earth Sciences 17:459-477.

Deposits of till, glaciofluvial, and glaciolacustrine sediments representing four glaciations are recognized in the Alberta portions of the Kananaskis Lakes 1:250 000 map sheet (82J). The oldest episode is represented by scattered erratics and patches of till above 1400 m in the Porcupine Hills. This episode involved nonsynchronous advances of Laurentide and Rocky Mountain ice sheets. The next glacial episode involved coalescence of Rocky Mountain and Laurentide ice in the eastern Foothills, north of the Porcupine Hills. The Rocky Mountain Maycroft Till, the Laurentide Maunsell Till, and the glaciolacustrine Chain Lakes Clays and Silts were deposited during this episode. The next glaciation involved the last coalescence of Rocky Mountain and Laurentide ice sheets in the vicinity of the study area. The Rocky Mountain Bow Valley Till and the mixed Rocky Mountain-Laurentide provenance Erratics Train Till were deposited during this episode along with the Foothills Erratics Train. The latest glaciation involved an advance of the Laurentide ice sheet to the eastern margin of the study area and the Rocky Mountain valley glaciers to the mountain front. One readvance of Rocky Mountain valley glaciers during retreat is recognized. The glaciolacustrine Midnapore Silts and Clays were deposited due to Laurentide ice damming of Bow River valley while the Canmore and Eisenhower Junction Tills were deposited by valley glaciers. On the basis of land mammal chronology, the two oldest glaciations are believed to be Illinoian in age. Radiocarbon evidence indicates the Erratics Train Glaciation to be at least Early Wisconsinan in age and the post-Erratics Train to be of Late Wisconsinan age.

Location : AEU, SCI, QE 1. C212
AEPAA and ADTMP, Periodicals collection
Areas : Map areas - 82 J
Borden areas - EP
Topics : Glacial chronology, Quaternary stratigraphy, Till - heavy minerals, Till - lithology

Jackson, Jr., L.E.
1980 Quaternary Stratigraphy and History of the Alberta Portion of the Kananaskis Lakes Map Area (82-J) and its Implications for the Existence of an Ice Free Corridor During Wisconsinan Time. Canadian Journal of Anthropology 1:9-10.

Abstract: No abstract available
Location : AEU, PMC, GN 1. C22
AEPAA, Periodicals collection
Areas : Map areas - 82 J
Borden areas - EP
Topics : Glacial chronology, Ice-free corridor, Quaternary stratigraphy

Jackson, Jr., L.E.
1979 New Evidence for the Existence of an Ice-free Corridor in the Rocky Mountain Foothills near Calgary, Alberta, During Late Wisconsinan Time. Current Research, Part A, pp. 107-111. Geological Survey of Canada, Paper 79-1A.

A 12 m core from a bog near Turner Valley, Alberta, has yielded ^{14}C dates of 18 400±380 years and 18 500±1090 years B.P. from near its bottom. These dates provide minimum ages for the end of the last glaciation during which Rocky Mountain provenance ice advanced east of the mountain front and covered much of the Foothills. A buried soil horizon near southeast Calgary lies between the youngest glacial till and glaciolacustrine silts. The stratigraphic position of the soil horizon precludes an advance of the Laurentide Ice Sheet into the Foothills since at least the end of the early Wisconsinan stage.

Location : AEU, SCI, QE 185. C2
Areas : Map areas - 82 J, 82 I
Borden areas - EP
Topics : Analysis of radiocarbon dates, Glacial chronology, Ice-free corridor, Palaeosols

Karlstrom, E.T.
1988 Soil Development in Quaternary Glacial Deposits, Waterton Park Area, Southwestern Alberta. Géographie physique et Quaternaire 42:147-162.

Pedological investigations in the Waterton Park area provide a useful means of testing subdivisions of Quaternary glacial deposits based on geomorphic relations. Soils in the region, however, including Podzols, Brunisols, Luvisols, and Chernozems, also reflect the influence of soil forming factors other than time. Nonetheless, a chronosequence can be established by comparing time-diagnostic properties of soils on different geomorphic units in areas with similar climate, vegetation, slope and parent material. Properties thought to be most diagnostic of relative soil age include thickness and degree of clay buildup in B horizons and two soil development indices which average degree of development with a number of properties. Pedologic and geomorphic data suggest surface deposits include mountain tills of three or four separate advances and continental tills of two separate advances. Mountain tills are tentatively correlated with the Late Wisconsinan (about 18 ka BP), Late and/or Early Wisconsinan (about 100 to 65 ka BP), Late Illinoian (about 200 to 132 ka BP), and Early Illinoian and/or pre-Illinoian (about 400 to 700+ ka BP), whereas continental tills are tentatively correlated with the Late Wisconsinan and late Illinoian deposits of the U.S. Midcontinent.

Location : AEU, PMC, G 1. R452
Areas : Map areas - 82 G, 82 H
Borden areas - DP
Topics : Glacial chronology, Palaeosols, Quaternary stratigraphy, Soil - chemical properties, Soil - clay mineralogy, Soil - pedogenesis, Soil - physical properties

Karlstrom, E.T.
1988 Multiple Paleosols in Pre-Wisconsinan Drift, Northwestern Montana and Southwestern Alberta. Catena 15:147-178.

Varying numbers of strongly developed paleosols occur on and between multiple pre-Wisconsinan diamict (mostly till) units which cap interfluves east of Waterton-Glacier Parks, southwestern Alberta and northwestern Montana. Investigation of stratigraphy, morphology and genesis of the paleosols permits subdivision of Quaternary deposits and estimation of the length and climatic characteristics of pre-Wisconsinan interglacials. Stratigraphic relations indicate at least five soils in five "tills" on Saint Mary Ridge and Mokowan Butte, up to three soils in four "tills" on Two Medicine Ridge, two soils in two "tills" on Milk River Ridge, and one soil in one "till" on Cloudy Ridge. Ages of diamicts probably range from late Pliocene to Kansan or early Illinoian. Because the paleosol-"till" sequences on Mokowan Butte and Saint Mary Ridges are not correlative, more than five pre-late Illinoian depositional and soil forming episodes are probably represented in the region. Paleosols generally include 1 to 5 m thick, reddish, leached, clay-rich argillic horizons overlying leached cambic or calcic horizons or indurated calcretes 4 to 15 m thick. Morphological, chemical and mineralogical properties of paleosols resemble those of Paleudalfs and Paleustalfs, suggesting the soils formed over long periods (0.02 to 2.68 Ma) under climates which were significantly warmer (by at least 6 degrees C) and moister than today's.

Abstract : Author's Summary
Location : AEU, SCI, GB 400. C35
Areas : Map areas - 82 H, Montana - Glacier National Park
Borden areas - DP, region as above
Topics : Palaeomagnetism, Palaeosols, Soil - chemical properties, Soil - pedogenesis, Soil - physical properties

Karlstrom, E.T.
1987 Stratigraphy and Genesis of Five Superposed Paleosols in Pre-Wisconsinan Drift on Mokowan Butte, Southwestern Alberta. Canadian Journal of Earth Sciences **24:2235-2253.**

Five paleosols in five superposed diamicts (probably tills) on Mokowan Butte permit subdivision of pre-Wisconsinan drift and a description of Quaternary and probably late Tertiary soil-forming environments. The surface soil and upper two buried paleosols (soils 5, 4, and 3, respectively) have strongly developed, 1-5 m thick, leached, reddish, clay-rich (20-48% clay), argillic horizons overlying indurated petrocalcic, calcic, or leached B horizons. The lower two buried paleosols (soils 2 and 1) are strongly developed and have 40-150 cm thick, clay-rich (18-49% clay) argillic horizons over calcic, petrocalcic, or leached B horizons. Based on their resemblance to Paleudalfs, Paleustalfs, or Palexerults, soils 5, 4, and 3 probably formed under interglacial climates that were moister and at least 6°C warmer than the present. Properties of soil 2 (Petrocalcic Paleustalf) and soil 1 (Typic Croboralf) imply soil formation under warm, semi-arid climates and a modern type of climate, respectively. Estimates of soil age based on degree of soil formation, paleomagnetic data, and regional correlation with dated glacial chronologies suggest soils 5 and 4 are in middle and early Pleistocene tills (= early Illinoian or Kansan and Nebraskan?), respectively, and soils 3, 2, and 1 are in late Pliocene till or diamict.

Location : AEU, SCI, QE 1. C212
AEPAA and ADTMP, Periodicals collection
Areas : Map areas - 82 H
Borden areas - DP
Topics : Palaeomagnetism, Palaeosols, Soil - chemical properties, Soil - pedogenesis, Soil - physical properties

Mathews, W.H.
1974 Surface Profiles of the Laurentide Ice Sheet in its Marginal Areas. Journal of Glaciology **13:37-43.**

Surface slopes of ice lobes can be estimated from the gradients of their margins as shown by ice limits, by contemporaneous recessional moraines, or by lateral melt-water channels, with allowance being made for the dip of an ice lobe laterally, as well as forward, toward its extremities. Profiles can be fitted approximately to a parabola with the equation

$$h = Ax^{\frac{1}{2}}$$

in which h is the height above and x the distance up-stream from the terminus, in the same units, and A is a coefficient which varies from glacier to glacier. The coefficient A has a value of 4.7 $m^{\frac{1}{2}}$ for both the Antarctic ice sheet inland from Mirny and the west central Greenland ice sheet. Several examples of late Pleistocene ice lobes within mountainous terrain of North America and New Zealand have values of A ranging from 2.9 $m^{\frac{1}{2}}$ to about 4.1 $m^{\frac{1}{2}}$. For several ice lobes in the south-western part of the late Pleistocene Laurentide ice sheet, however, values are from about 0.3 to 1.0 $m^{\frac{1}{2}}$, corresponding to basal shear stress of from about 0.07 to 0.22 bar. A major problem exists in accounting for the active movement of ice here under such low surface gradients and basal shear stresses. Evidence of basal slip, aided by high subglacial water pressure, should be looked for in the field. Alternatively, other possibilities for the explanation of such low surface gradients should be sought.

Location : AEU, SCI, QE 575. J86

Areas : Map areas - 72 C, 72 L, 82 G, 82 H, 82 I, 82 J, 84 SW, Montana - Northern,
Saskatchewan - Southern
Borden areas - DO, DP, EO, EP, HQ, regions as above
Topics : Ice sheet profiles

Osborn, G.D.

1985 Holocene Tephrostratigraphy and Glacier Fluctuations in Waterton Lakes and Glacier National Parks, Alberta and Montana. Canadian Journal of Earth Sciences 22:1093-1101.

Waterton Lakes National Park in Alberta and Glacier National Park in Montana lie along adjacent sections of the continental divide in the Rocky Mountains. In cirques or near divides there is evidence for two ages of glacial deposits. Younger deposits are generally well preserved, poorly vegetated, and bear no tephra and no or very small lichens. Older deposits are more poorly preserved, better vegetated, bear Rhizocarpon sp. lichens at least up to 92 mm in diameter, and bear tephra. The tephra often occurs in two different coloured horizons, but both are compositionally equivalent to Mazama tephra.

The older advance has a minimum age of about 6800 ^{14}C years BP. and a probable maximum age of about 12 000 ^{14}C years BP. It is correlated with the pre-Mazama Crowfoot Advance of the Canadian Rockies. Deposits of the younger advance are probably not too much older than mid-19th century, because some glaciers began retreating from the deposits about then. The younger advance is correlated to the Cavell Advance of the Canadian Rockies and the Gannett Peak Advance of the American Rockies.

Both advances were minor. The older advance left moraines about 1.5 km or less beyond present glacier margins and depressed ELA's an average of 40 m below modern values.

Location : AEU, SCI, QE 1. C212
AEPAA and ADTMP, Periodicals collection
Areas : Map areas - 82 G, 82 H, Montana - Glacier National Park
Borden areas - DP, region as above
Topics : Lichenometry, Glacial chronology, Neoglaciation, Tephra -Mazama

Osborn, G.

1982 Holocene Glacier and Climate Fluctuations in the Southern Canadian Rocky Mountains: A Review. In Holocene Glaciers, edited by W. Karlén, pp. 15-25. Striae, Volume 18.

In the southern Canadian Rockies Late Pleistocene glaciers retreated to close to their present limits by roughly 10 000 years B.P. There is evidence of two minor readvances of ice since that retreat, one prior to 6600 B.P. and one within the last several centuries. Another minor advance of intermediate age is suggested by deposits at one site. With regard to interpretation of pollen spectra and macrofossils, there is some consensus that a) prior to c. 7500 years B.P. one or more episodes of relatively cool/wet climate occurred, b) a shift towards cool/wet climate at c. 6000 years B.P. ended the warmest/driest part of the Holocene, c) further cooling occurred at c. 3000 years B.P., and d) the last few centuries may have been the coolest/wettest episode of the Holocene. Preliminary, unpublished results of oxygen isotope analysis of wood by B. Luckman suggest that mean annual temperature at c. 5900 years B.P. was 1.9° C higher than at present at a site in Jasper National Park.

Location : AEU, SCI, QE 741. N832
Areas : Map areas - 82 G, 82 H, 82 J, 82 N, 82 O, 83 C, 83 D, 83 E, 83 F
Borden areas - DP, EP, EQ, FQ
Topics : Dendrochronology, Glacial chronology, Holocene timberline fluctuations, Lichenometry, Oxygen isotope studies, Pollen analysis, Tephra - Mazama

Osborn, G.D.

1980 Preliminary Observations on Holocene Glacier Fluctuations in Waterton-Glacier International Peace Park. Proceedings of the Second Conference on Scientific Research in National Parks, San Francisco, Volume 5: Physical Sciences, pp. 307-319. National Parks Service, Washington, D.C.

Relative-age-dating criteria, superposition of deposits, and volcanic ash stratigraphy show that there are two ages of moraines and/or rock glaciers present in some cirques in Waterton-Glacier Park. Lichenometry suggests that the inner moraines, which bear no ash, date from the last few centuries. The outer moraines bear Mazama ash (6600 B.P.) and in some cases an older ash of unknown identity and age. Thus there is evidence for very minor Early Holocene (or possibly Late Pleistocene) and recent glacier expansions. Ice has not advanced out of cirques for most, and possibly all, of Holocene time.

Note : Publication was produced on microfiche.
Location : IC
Areas : Map areas - Montana - Glacier National Park
Borden areas - region as above
Topics : Lichenometry, Neoglaciation, Tephra - Mazama, Tephra - unknown source

Reeves, B.

1967 The Alluvial Sequence in Southwestern Alberta: New Evidence for Post-glacial Climatic Change. Archaeology in Montana 8(2):11-13.

Abstract: No abstract available
Location : AEU, PMC, F 726. A67
Areas : Map areas - 82 H
Borden areas - DP
Topics : Geomorphology - alluvial sequences

Rutherford, L.

1941 Some Aspects of Glaciation in Central and Southwestern Alberta. Transactions of the Royal Society of Canada 35(4):115-124.

The southern half of Alberta was glaciated by ice from both the Keewatin and Cordilleran centres. In south-western Alberta, the glacial deposits were first studied in some detail in 1882-4 by Dawson (1885) who, in 1894, accompanied by McConnell, returned to this area since it seemed to contain evidence of considerable importance to the interpretation of the glacial history of North America (1895). Alden (1924, 1932), while studying the glacial features of Montana, extended his observations into southern Alberta, and some general interpretations of the glacial history of this part of Alberta have also been made by

Coleman (1926) and by Antevs (1928).

These workers attempted to determine the boundaries of the deposits from the two ice sources and to explain the apparent overlap of the two drifts and also some features of distribution with respect to elevations in south-western Alberta. There have been several contributions to our knowledge on the glacial deposits on the plains of Alberta and areas adjacent to the east. The interpretation of the glacial history on the plains is to some degree dependent on a correct interpretation of the contemporaneous history in the south-west foothills.

The following discussion deals with some aspects of glaciation in Alberta, particularly with reference to uplift, erosion, ice advances, and distribution of large erratic boulders. Most of the features referred to are shown on Fig. 1.

Abstract: Author's Introduction
Location: AEU, HSS, AS 42. R8853
Areas: Map areas - 72 E, 72 L, 72 M, 73 D, 73 E, 82 G, 82 H, 82 NE, 83 C, 83 F, 83 SE
Borden areas - DO, DP, EO, EP, FO, FP, FQ
Topics: Erratics, Glacial chronology, Glacial geomorphology, Glacial geomorphology - moraines, Ice sheet profiles

Sanborn, P., and S. Pawluk
1980 An Early Holocene Solodic Paleosol near Priddis, Alberta. Canadian Journal of Earth Sciences 17:1323-1330.

An early Holocene paleosol was found beneath Mazama Ash (ca. 6600 BP) near Priddis, Alberta. The paleosol pedon has strong textural and morphological differentiation, with an eluvial surface horizon, thick prismatic transitional horizon, and a Btb horizon containing both illuvial clay and organic matter. A Solonetz to Solod genetic sequence is inferred, probably related to changes in groundwater regime caused by stream entrenchment.

Location: AEU, SCI, QE 1. C212
AEPAA and ADTMP, Periodicals collection
Areas: Map areas - 82 J
Borden areas - EP
Topics: Palaeosols, Soil - chemical properties, Soil - pedogenesis, Soil - physical properties

Shetsen, I.
1984 Application of Till Pebble Lithology to the Differentiation of Glacial Lobes in Southern Alberta. Canadian Journal of Earth Sciences 21:920-933.

Variations in the pebble composition of surface till in southern Alberta indicate the presence of three contemporaneous lobes in the last continental glacier. The ice lobe domains have similar pebble associations and differ only in the frequency of occurrence of rock constituents. A large part of the percentage variability within each domain is caused by irregular entrainment of locally derived stones, which dilutes pebble contents and results in a lithology substantially different from the provenance composition. The study has shown that the regional trends are preserved and can be recognized in the locally modified lithologies, but the latter have to be isolated and evaluated differently from the regular provenance lithologies. The common diluting agent in the area is fluvial gravel that is widespread on erosional bedrock surfaces and in preglacial valleys. Because the gravel is generally coarse, pebble fractions of larger size are more affected by local dilution than are successively finer fractions. Quantitative comparison of rock contents in two size ranges helps to identify the regional and local types of pebble composition and to segregate petrological data into two corresponding sets. Source indices are calculated then as a function of three lithologic variables, for each of the sets separately. The indices have similar values in nondiluted and diluted samples of a given area and distinguish well between tills deposited by glaciers with different directions of regional flow.

Location : AEU, SCI, QE 1. C212
AEPAA and ADTMP, Periodicals collection
ARC, Contribution Series 1285
Areas : Map areas - 72 E, 72 L, 72 M, 82 H, 82 G, 82 NE
Borden areas - DO, DP, EO, EP
Topics : Glacial chronology, Ice movement indicators, Till - lithology

Stalker, A. MacS.
1983 Quaternary Stratigraphy in Southern Alberta Report III: The Cameron Ranch Section. Geological Survey of Canada Paper 83-10. (20 pp.)

The Cameron Ranch Section is the most complete Laurentide Pleistocene section found in southern Alberta. It probably contains the full Laurentide glacial record for the region, including deposits from all the Illinoian and Wisconsin glacier advances. The deposits lack fossils or other materials for dating, and therefore age assignments are made on the basis of correlation with other sections, particularly those near Medicine Hat.

At the base bedrock is overlain by the preglacial Saskatchewan Gravels and Sands. These consist of a lower gravel member that probably is of late Kansan Age, and an overlying silt member laid down as the first Pleistocene ice sheet approached during late Yarmouthian or early Illinoian time. Both units lack the stones brought from the Canadian Shield by glaciers.

The rest of the sequence, consisting of till sheets with interfingering beds of alluvial and lacustrine sand, silt, and clay, is divided into fifteen units, nine or ten of which represent separate Laurentide ice advances; Cordilleran glaciation is not evident. The lowest four units overlying the Saskatchewan Gravels and Sands are mainly till and represent three or four separate glaciations of Illinoian Age. Weathering is displayed on two of the till sheets. A thin Sangamon silt unit separates these units from four Preclassical Wisconsin units, three of which demonstrate separate ice advances. These, in turn, are overlain by a thin, Mid-Wisconsin sand unit followed by five Classical Wisconsin units, three of which are basically till and record individual ice advances. The top unit in the section consists of lake silt laid down as the last ice sheet was retreating.

The name "Cameron Ranch Formation" is here given to certain previously unnamed deposits that consist mostly of till. It is of Preclassical Wisconsin Age.

Location : AEU, SCI, QE 185. C2
Areas : Map areas - 82 H
Borden areas - DP
Topics : Glacial chronology, Quaternary stratigraphy

Stalker, A. MacS.

1980 The Geology of the Ice-free Corridor: the Southern Half. Canadian Journal of Anthropology 1:11-13.

Abstract: No abstract available
Location: AEU, PMC, GN 1. C22
Areas: Map areas - 72 E, 72 L, 82 G, 82 H, 82 NW, 83 A, 83 B
Borden areas - DO, DP, EO, EP, FP
Topics: Glacial chronology, Ice-free corridor

Stalker, A. MacS.

1977 The Probable Extent of the Classical Wisconsin Ice in Southern and Central Alberta. Canadian Journal of Earth Sciences 14:2614-2619.

The margin of a former Laurentide ice sheet is traced through southern and central Alberta, from the Saskatchewan border southeast of Medicine Hat to beyond Rocky Mountain House, southwest of Edmonton. This margin, which marks the limit of a significant glacier advance or readvance, is thought to represent the maximum extent of Laurentide ice on the Canadian prairies during Classical Wisconsin time. In the south this margin follows a well-developed hummocky moraine; in the north it is indicated mainly by a discordance in trend of ice-flow markings, a disruption of drainage, and a change in maturity of topography on either side.

Location: AEU, SCI, QE 1. C212
AEPAA and ADTMP, Periodicals collection
Areas: Map areas - 72 E, 72 L, 82 G, 82 H, 82 NW, 83 A, 83 B
Borden areas - DO, DP, EO, EP, FP
Topics: Glacial chronology, Glacial geomorphology

Stalker, A. MacS.

1973 Surficial Geology of the Kananaskis Research Forest and Marmot Creek Basin Region of Alberta. Geological Survey of Canada Paper 72-51. (25 pp.)

The Kananaskis Research Forest-Marmot Creek Basin lies along the Kananaskis River within the front ranges of the Rocky Mountains, some fifty miles west of Calgary. The mapped area covers 54 square miles.

Four major glaciers are recorded, each smaller than the previous one. The first three advanced down the Kananaskis Valley to join glaciers in Bow Valley, north of the area, but the fourth apparently terminated in the region of Barrier Lake, short of the Bow Valley. The first covered all but the highest points in the area but, as all the glaciers left very little drift in upland districts, bedrock is exposed over three-quarters of the area. Frost-produced rubble covers much of the unglaciated area.

The bulk of the surficial deposits are found in the valleys. They consist of: glacial deposits of outwash and valley fill; glacial and postglacial deposits laid down in streams and lakes during retreat of the last glacier, generally while Bow Valley ice blocked the north end of Kananaskis Valley; and postglacial stream, fan and mass wasting deposits. Ground moraine, fan deposits, and postglacial alluvium form most of the surficial cover, but outwash and lake sediment predominate in certain parts of the Research Forest.

The four glaciers probably span all Wisconsin, and perhaps some pre-Wisconsin, time.

It is suggested that the last reached its maximum between 12,000 and 10,000 years ago, and that it corresponds to the Canmore advance in Bow Valley.

Location : AEU, SCI, QE 185. C2
AEPAA, 571.1 C16P 72-15
Areas : Map areas - 82 O, 82 J
Borden areas - EP
Topics : Glacial chronology, Quaternary stratigraphy

Stalker, A. MacS.
1970 A Probable Late Pinedale Terminal Moraine in Castle River Valley, Alberta: Reply. Geological Society of America Bulletin 81:3775-3778.

Abstract: No abstract available
Location : AEU, SCI, QE 1. G341
AEPAA, Periodicals collection
Areas : Map areas - 82 G
Borden areas - DP
Topics : Glacial chronology, Glacial geomorphology

Stalker, A. MacS.
1969 Geology of the Early Man Site at Taber. American Antiquity 34:425-428.

Human bones, found by the writer's geological field party in 1961, came from a cliff (Woodpecker Island Bluff) on the east side of Oldman River about 3 mi. north of Taber, Alberta. This paper discusses stratigraphy of the bluff and age of the bones, which have been described by Langston and Oschinsky (1963). The bones cannot be dated directly; however, they were found about 60 ft. below prairie level, in a sand unit lying beneath a till sheet. As the till was deposited by a Classical Wisconsin ice sheet that spread over the area more than 22,000 years ago, the bones are at least that old. Correlation with other bluffs along Oldman River indicates they are more than 32,000 years, and probably more than 37,000 years, old.

Location : AEU, PMC, CC 1. A6
AEPAA, Periodicals collection
Areas : Map areas - 82 H
Borden areas - DP
Topics : Archaeological sites - DlPa-4, Geoarchaeology, Taber child

Stalker, A. MacS.
1969 A Probable Late Pinedale Terminal Moraine in Castle River Valley, Alberta. Geological Society of America Bulletin 80:2115-2122.

Radiocarbon dates from the Castle River Valley of southwestern Alberta indicate that the last major glacier advance down that valley reached its maximum extent 6200 radiocarbon years ago. This advance is considered to be late Pinedale in age. The Pinedale then ended with onset of the "Climatic Optimum" or "Altithermal" which lasted in that region from about 6000 to 4500 years B.P.

The dates were obtained on bison bones found in outwash near the base of a 250-ft.-high cliff. This cliff, here called Mountain Mill Bluff, lies on the south side of Castle River, 7 miles east of the Rocky Mountains and 6 miles due west of the town of Pincher Creek. The lower part of the outwash extends downvalley from a terminal moraine (Mountain Mill Moraine) of the former Castle Valley Glacier. This bison wandered into a meltwater stream draining from that glacier about 6200 years ago, drowned, and were buried by outwash accumulating below the moraine. As moraine and outwash were laid down contemporaneously, dates on the bison bones indicate the time of construction of the moraine.

Location : AEU, SCI, QE 1. G341
AEPAA, Periodicals collection
Areas : Map areas - 82 G, 82 H
Borden areas - DP
Topics : Analysis of radiocarbon dates, Faunal remains - Bison, Glacial chronology, Glacial geomorphology, Molluscs, Palaeosols, Quaternary stratigraphy

Stalker, A. MacS.
1963 Surficial Geology of Blood Indian Reserve No. 148, Alberta. Geological Survey of Canada Paper 63-25. (20 pp.)

Abstract: No abstract available
Location : AEU, SCI, QE 185. C2
Areas : Map areas - 82 H
Borden areas - DP
Topics : Glacial chronology, Quaternary stratigraphy

Stalker, A. MacS.
1963 Quaternary Stratigraphy in Southern Alberta. Geological Survey of Canada Paper 62-34. (52 pp.)

The remarkable exposures of Quaternary deposits along the river valleys of southern Alberta have long been of great interest to geologists. These deposits are well displayed where the modern rivers cut deeply into the fill contained in the deep and broad, buried preglacial valleys. Twelve of the more important stratigraphic sections through these surficial deposits are described here. ... These sections were chosen because of their importance in regional correlation, because of the number and thickness of glacial and interglacial units represented, and because of their accessibility. They are mainly along Oldman and Castle Rivers, but include representative corresponding sections from each of the St. Mary, Bow, and Red Deer Rivers. ...

The broad, deep preglacial valleys formed excellent locales for preserving from destruction by later glaciers the successive deposits laid down in them. Thus deposits of the first glacier are normally present at the base of the valley fill, just above bedrock or preglacial gravel and sand, and deposits from several of the later glaciers are also generally present. However the stratigraphic section exposed by action of the modern rivers varies greatly from place to place, in both number and thickness of units present. These features can even vary greatly within a single, long exposure. As a result the general stratigraphic section given in this report, and also the descriptions of individual sections (particularly Sections 3, 5, and 10, in the Appendix) are composite. In most instances the maximum thickness of a unit or bed in the section is stated, although the unit may vary greatly in thickness laterally, or even be missing from parts of the exposure. In addition the exposures, and thus the apparent sections, change continuously over the years and may even be destroyed by stream dissection or slumpage, or covered by vegetation. On the other hand, new exposures are often developed by rivers impinging on their banks. Such processes are slow, however. For example most of the exposures reported by Dawson in 1885 remain much as he described them.

Of the sections described in the Appendix, Nos. 5 and 10 are the most complete, are little deformed or slumped, are readily examined, and are used as the reference sections for the Laurentide deposits. The sequence in these two sections is remarkably similar.

Throughout the report the names "Albertan till", "Labuma till", Maunsell till", "Buffalo Lake till", and "Brockett till" are used where applicable. ... [The first four names have been used in previous publications] ... "Brockett till" is first used in this paper.

Abstract : Shortened and adapted from the Author's Introduction
Location : AEU, SCI, QE 185. C2
AEPAA, 557.1 C16P 62-34
Areas : Map areas - 72 E, 72 L, 82 G, 82 H, 82 I, 83 A
Borden areas - DO, DP, EO, EP, FP
Topics : Review of Quaternary stratigraphy

Stalker, A. MacS.
1960 **Ice-pressed Drift Forms and Associated Deposits in Alberta. Geological Survey of Canada Bulletin 57. (38 pp.)**

The various forms of 'ice-pressed' features that occur in the Pleistocene deposits of Alberta are described and a general explanation of their origin is given. The significance of the forms in the history of deglaciation and their relation to the large hummocky moraines of the prairies are also briefly discussed.

These features, which are to be expected in any hummocky moraine in any area where ice stagnation and suitable material occurred, were formed during retreat of the last glacier in broad, marginal belts of the ice-sheet and also where the ice was thin over high land. This indicates that the sub-glacier material probably was not frozen during this stage of deglaciation.

It is concluded that these features were formed by a process of pressing or squeezing of sub-ice material into nearby tunnels, holes and crevasses in the ice-sheet.

Moraines of Alberta may represent changes in rate of, or halts in the lowering of the surface of the ice-sheet and should be correlated by altitude rather than by position.

The various ice-pressed forms are illustrated by a comprehensive selection of air and ground photographs.

Location : AEU, SCI, QE 185. A43
Areas : Map areas - 72 G, 72 L, 72 M, 73 D, 73 E, 82 H, 82 I, 82 O, 82 P, 83 SE
Borden areas - DO, DP, EO, EP, FO, FP
Topics : Glacial geomorphology - "ice-pressed" features

Stalker, A. MacS.
1958 Kipp Section: A Pleistocene Age-Date. Journal of the Alberta Society of Petroleum Geologists 6:252.

Abstract : No abstract available
Location : AEU, SCI, TN 860. A32
AEPAA and ADTMP, Periodicals collection
Areas : Map areas - 82 H
Borden areas - DP
Topics : Analysis of radiocarbon dates, Quaternary stratigraphy

Stalker, A. MacS.
1958 Kipp Section: Type Pleistocene. Journal of the Alberta Society of Petroleum Geologists 6:229-232.

Altogether, therefore, the Kipp section shows two tills with a good section of inter-till deposits, but it also shows strong indications that there were two glacier advances after the deposition of the upper of these tills, and there is a possibility that the lower till may in itself represent two glacier advances.

Abstract : Author's concluding paragraph
Location : AEU, SCI, TN 860. A32
AEPAA and ADTMP, Periodicals collection
Areas : Map areas - 82 H
Borden areas - DP
Topics : Quaternary stratigraphy

Stalker, A. MacS.
1956 The Erratics Train Foothills of Alberta. Geological Survey of Canada Bulletin 37. (28 pp.)

Large blocks of quartzite and pebbly quartzite, scattered along a narrow belt in the foothills of southwestern Alberta and the adjacent plains, have attracted considerable attention ever since their first discovery. The largest and best known of these is "Big Rock", just north of the highway to Turner Valley at a point 5 miles west of Okotoks. ...

The pebbly quartzite erratics train of southwestern Alberta is the result of a unique and short-lived set of circumstances. The writer believes that a bed of well jointed quartzite and pebbly quartzite that could be quarried in large blocks by a glacier was the prime factor. The bed was in such a position that an eastward-flowing valley glacier in the Rocky Mountains north of Calgary received large blocks of the quartzite on its surface. Southward-flowing Laurentide ice present to the east, and with its western margin more or less controlled by the westward rise of land, deflected the flow of the mountain ice that was carrying the blocks, and diverted it southward along the margin of the Laurentide ice, or else received and carried the blocks of quartzite itself. The transporting glacier then distributed these block in a belt several hundred miles long, and within a range of elevation controlled by the approximate surface of the Laurentide ice. This glacier was presumably of Wisconsin age. No subsequent glacier has been strong enough to overrun the area of the erratics train except at its southernmost end. The various factors necessary for the formation of the erratics train were present during only one of the glaciations of the area, and then only for a relatively short time at the maximum or during the retreat of this ice-sheet. Only one large erratics train of this type rock was formed in southwestern Alberta.

Abstract : Parts of the Author's Introduction and Conclusion
Location : AEU, SCI, QE 185. A43,
AEPAA, 557.1 C16B 37
Areas : Map areas - 82 H, 82 I, 82 J, 82 O, 82 P, 83 B, 83 C, 83 F
Borden areas - DP, EP, FP, FQ
Topics : Erratics train, Glacial chronology, Glacial geomorphology, Quaternary stratigraphy

Stalker, A. MacS., and J.E. Harrison
1977 Quaternary Glaciation of the Waterton-Castle River Region of Alberta. Bulletin of Canadian Petroleum Geology 25:882-906.

The Waterton-Castle River Region includes the extreme limits of advance of both Cordilleran glaciers flowing from the Rocky Mountains eastward towards the plains, and massive Laurentide glaciers advancing upslope from the plains and the Canadian Shield towards the mountains. Its glacial record, which spans about the last third of the Quaternary Period, can be divided into four events. Each consists of a Cordilleran glacier and a corresponding Laurentide one, though during the last event Laurentide ice failed to reach the region. The record also includes the late neoglaciation found near the heads of mountain valleys. Undoubtedly, many Pleistocene glaciers are not represented in the record, because their deposits have been destroyed by later ones. Although this fact may explain the apparent absence of pre-Illinoian Cordilleran glaciers, pre-Illinoian Laurentide glaciers definitely did not reach the region.

The glaciations of the region show a steady decrease in intensity and strength. The first, of Illinoian age, is here called the Great Glaciation, and its glaciers the Great Cordilleran and Great Laurentide glaciers. These were immense glaciers, far surpassing in magnitude any others before or after. The Great Cordilleran Glacier left drift in the preglacial valleys far out onto the plains, and on high areas in the foothills such as Mokowan Butte and Cloudy Ridge just east and north of Waterton Park respectively. During this time the park lay under a great ice-dome with only its highest peaks possibly protruding. The Great Laurentide glaciers dropped Shield stones high on the mountain front and spread till over the mountain drift in the preglacial valleys.

Later, during Wisconsin time, Cordilleran glaciers were confined to valleys in the mountains and spread only a short distance onto the plains. Laurentide glaciers likewise were much reduced in size. The first was about 800 ft (240 m) lower then the Great Laurentide Glacier, the following one another 1,000 ft (300 m) lower, and the next one 600 ft (180 m) lower again.

All the Cordilleran glaciers of the region had undergone substantial retreat before Laurentide glaciers arrived on the scene, and the amount of contact between the two types is not known. It possibly was substantial during the Great Glaciation, but none or very little during the next. During succeeding glaciations the Cordilleran and Laurentide glaciers did not meet within the region.

Location : AEU, SCI, TN 860. A32
AEPAA and ADTMP Periodicals collection
Areas : Map areas - 82 G, 82 H
Borden areas - DP

Topics: Glacial chronology, Quaternary stratigraphy

Stene, L.P.
1979 Polyframboidal Pyrite in the Tills of Southwestern Alberta. Canadian Journal of Earth Sciences 16:2053-2057.

This investigation shows that older tills in southwestern Alberta contain polyframboidal pyrite which is of in situ origin.

Location: AEU, SCI, QE 1. C212
AEPAA and ADTMP Periodicals collection
Areas: Map areas - 82 G, 82 H, 82 I, 82 J
Borden areas - DP, EP
Topics: Till - heavy minerals

Wagner, W.P., and D.F. Eschman
1970 A Probable Late Pinedale Terminal Moraine in Castle River Valley, Alberta: Discussion. Geological Society of America Bulletin 81:3773-3774.

Abstract: No abstract available
Location: AEU, SCI, QE 1. G341
Areas: Map areas - 82 G
Borden areas - DP
Topics: Glacial chronology, Quaternary stratigraphy

Waters, P.L., and N.W. Rutter
1984 Utilizing Paleosols and Volcanic Ash in Correlating Holocene Deposits in Southern Alberta. In Correlation of Quaternary Chronologies, edited by W.C. Mahaney, pp. 203-223. GeoBooks, Norwich, England.

In a widespread area of southern Alberta, paleosols have been recognized in post-glacial sediments. These deposits consist of alluvial, colluvial and lacustrine material. In many cases, a layer of volcanic ash occurs either directly in contact with or a few centimeters above the paleosols.

Examination of eight sections reveals that, at seven localities, Mazama ash overlies the paleosols. At the remaining locality, Mazama ash is present, but it has been reworked to some extent. This suggests that the paleosols are penecontemporaneous profiles. The paleosols have been classified as members of the Chernozemic and Regosolic Orders. Phytoliths contained in the Ah horizons indicate a vegetative suite dominated by short grasses.

Interpretation of the data suggests these soils developed under a warmer and drier climate than the present. This development indicates a period of non-deposition, when a stable landscape existed over southern Alberta. This period of climatic amelioration appears to represent the Altithermal Interval in Western Canada. The immature nature of the soils supports the idea of the period being short-lived, ending by the time of Mazama ash deposition (6600 yr BP). Sedimentation resumed and appears continuous with no other major periods of soil development until the formation of the present day profiles.

Location : AEU, SCI, QE 696. C82 1984
AEPAA, 551.79 Q29
Areas : Map areas - 82 G, 82 H, 82 NE, 83 A, 83 B, 83 H
Borden areas - DP, EP, FP
Topics : Opal phytoliths, Palaeosols, Soil - chemical properties, Soil - pedogenesis, Soil - physical properties, Tephra - Mazama

c. Central Western Corridor

Barendregt, R.W.

1987 The Geomorphology of the Drumheller Badlands. In Geology of the Calgary Area, edited by L.E. Jackson, Jr., and M.C. Wilson, pp. 89-95. Canadian Society of Petroleum Geologists, Calgary, Alberta.

Abstract : No abstract available
Location : ILL, ACSP, QE 186.9 J15 1987
Areas : Map areas - 73 L, 73 M, 82 P, 83 A
Borden areas - EO, EP, FP
Topics : Bedrock geology, Sediments - clay mineralogy, Geomorphology -badlands

Beaudoin, A.B., and R.H. King

1986 Using Discriminant Function Analysis to Identify Holocene Tephras Based on Magnetite Composition: A Case Study from the Sunwapta Pass Area, Jasper National Park. Canadian Journal of Earth Sciences 23:804-812.

The magnetite composition from three sets of samples of Mazama, St. Helens set Y, and Bridge River tephras from Jasper and Banff national parks are used to test whether discriminant function analysis can unambiguously distinguish these tephras. The multivariate method is found to be very sensitive to the change in reference samples. St Helens set Y tephra is clearly distinguished. However, discrimination between Mazama and Bridge River tephras is less distinct. A set of unknown tephras from the Sunwapta Pass area was used to test the classification schemes. Unknown tephras are assigned to different tephra types depending on which reference tephra set is used in the discriminant function analysis.

Location : AEPAA and ADTMP, Periodicals collection
AEU, SCI, QE 1. C212
Areas : Map areas - 82 N, 83 C
Borden areas - EQ, FQ
Topics : Tephra - Bridge River, Tephra - identification, Tephra - Mazama, Tephra - St. Helens

Boydell, A.N.

1978 Multiple Glaciations in the Foothills, Rocky Mountain House Area, Alberta. Research Council of Alberta Bulletin 36. (35 pp.)

The results of this study of the surficial deposits in the Rocky Mountain House area (Rocky Mountain Foothills region) indicate that in Wisconsin times the study area experienced multiple glaciations. Only one Laurentide advance (Athabasca-Sylvan Lake) was documented, but this ice probably remained in the area for the whole of the Late Wisconsin. One Early Wisconsin (Hummingbird-Baseline) and two Late Wisconsin (Lamoral and Jackfish Creek) Rocky Mountain advances were also documented. One "old glacial" area (Brazeau and Ram Ranges) situated above 5500 ft (1660 m) was glaciated during the Early Wisconsin but remained ice free in Late Wisconsin times. A number of proglacial lakes, impounded by Late Wisconsin ice masses, formed in the river valleys. A major lake (glacial Lake Caroline) occupied a substantial portion of the area during deglaciation. Rocky Mountain meltwaters were impounded by the Laurentide ice mass and cut successively lower spillways in the east and southeast. The entire study area was probably ice free soon after 9600 BP.

During the course of this study, the surficial deposits were mapped, and samples were taken from exposures and from material collected by dry auger drilling. Supplementary laboratory tests included till fabric analysis, and lithological, heavy mineral, and carbonate analyses. Only heavy mineral analysis and pebble counts were found to be useful for differentiating among the tills. The relative ages of the three Rocky Mountain advances were established from stratigraphic and morphological evidence, because of a lack of suitable radiometric data.

Location : AEU, SCI, QE 186. R415 No. 36
AEPAA, 551.314 B692
ARC, Bulletin 36
Areas : Map areas - 83 B
Borden areas - FP
Topics : Glacial chronology, Glacial lake sequences, Quaternary stratigraphy, Till - heavy minerals, Till - lithology

Dormaar, J.F., and L.E. Lutwick
1975 Pyrogenic Evidence in Palesols along the North Saskatchewan River in the Rocky Mountains of Alberta. Canadian Journal of Earth Sciences 12:1238-1244.

Vertical sections of palesols along the Upper North Saskatchewan River valley show horizons that have distinct brown to reddish-brown colors. Based on such criteria as time for water droplet penetration, magnetic susceptibility, and crystallization of Fe oxides, together with present conditions and vegetation of the fans and floodplain in that area, it was concluded that these brown horizons were fire-affected. The organic debris in the bogs before a fire is continually being enriched with silt blowing from the floodplain. The colored horizons are considered to be a combination of accessed eolian matter reddened in the layer of burning debris and some mineral matter reddened by conducted heat.

Location : AEPAA and ADTMP, Periodicals collection
AEU, SCI, QE 1. C212
Areas : Map areas -83 C
Borden areas -FQ
Topics : Fire history, Soil - pedogenesis, Tephra - Mazama, Tephra - St. Helens

Dumanski, J., S. Pawluk, C.G. Vucetich, and J.D. Lindsay
1980 Pedogenesis and Tephrochronology of Loess Derived Soils, Hinton, Alberta. Canadian Journal of Earth Sciences 17:52-59.

The loess derived soils of the Hinton district provide a record of soil formation for the entire postglacial period. Loess originates from the shorelines of Brûlé Lake and from the sandbars and braided channels of the Athabasca River.

The geochronology of the loess, as established through the study of paleosols and volcanic ash beds, indicates that loess deposition was continual but irregular. Soil formation occurred contemporaneously with loess deposition, and varying soil morphologies were attributed to differing local rates of loess accumulation. There was no evidence for marked climatic change during the Holocene in the study area, but increased loess supply after 4000 years BP may reflect gradual change.

Location : AEU, SCI, QE 1. C212
AEPAA and ADTMP, Periodicals collection
ARC, Contribution Series 1001
Areas : Map areas - 83 F
Borden areas - FQ
Topics : Loess - sedimentary characteristics, Palaeosols, Soil - pedogenesis, Tephra - Mazama, Tephra - St. Helens

Eyles, N., B.M. Clark and J.J. Clague
1988 Reply. Sedimentology 35:529-530.

Note : Reply to Shaw (1988) comments on **"Late Pleistocene Subaerial Debris-flow Facies of the Bow Valley, near Banff, Canadian Rocky Mountains"**
Abstract : No abstract available
Location : AEU, SCI, QE 581. A154
Areas : Map areas - 82 O
Borden areas - EP
Topics : Paraglacial processes, Sedimentology - debris flows, Sedimentology - processes

Eyles, N., C.H. Eyles and A.M. McCabe
1988 Late Pleistocene Subaerial Debris-flow Facies of the Bow Valley, near Banff, Canadian Rocky Mountains. Sedimentology 35:465-480.

A thick late Pleistocene sequence, comprising multiple beds of massive diamict facies resting on outwash gravels, occurs along the Bow River, near Banff, Alberta. Diamicts have a simple sheet-like geometry which dip downvalley at between 5° and 10°, with largely conformable bedding contacts. The sediments are strongly bimodal in texture, consisting of clasts supported by a silty sand matrix. Prolate clasts show a weak -axis alignment parallel and transverse to the trend of the Bow Valley with a weak imbrication. Clasts of soft sediment are common. The diamict sequence has a maximum thickness of 30 m, infills the valley floor over an area of approximately 12 km^2 and buries a channelled topography cut on the surface of underlying outwash gravels. Abandoned braided channels, veneered by windblown sand containing volcanic tephra dated at 6600 yr BP, occur on the infill surface.

Diamict facies were emplaced as subaerial debris flows derived by the mixing and remobilization of large volumes of outwash and glaciolacustrine sediment. Orientation data from clasts and a few basal grooves indicate that debris was derived upvalley and from adjacent valleyside slopes. A major episode of debris flow sedimentation may have been triggered by the abrupt drainage of lakes in tributary valleys as the Bow Valley glacier retreated. Downslope resedimentation of large volumes of sediment resulted in braided river aggradation downstream along the Bow River and can be dated to between 12 000 and 10 000 yr BP. Similar conditions probably occurred during deglaciation throughout the Canadian Cordillera and many other alpine areas, where poorly-sorted late glacial debris-flow facies have been mistaken for tills deposited directly by glaciers. The late glacial setting identified in this paper provides a basis of comparison with ancient continental glacial facies preserved in areas of active tectonism and high relief.

Location : AEU, SCI, QE 581. A154
Areas : Map areas - 82 O

Borden areas - EP
Topics : Paraglacial processes, Sedimentology - debris flows, Sedimentology - processes

Harris, S.A.

1987 Early Holocene Climate and Palaeogeography, High Plains, Alberta. In Man and the Mid-Holocene Climatic Optimum, edited by N.A. McKinnon and G.S.L. Stuart, pp. 33-51. Proceedings of the Seventeenth Annual Conference of the Archaeological Association of the University of Calgary, Nov. 10-12, 1984.

At 11,000 B.P. three main ice masses were present in Western Canada. The Cordilleran ice still covered much of British Columbia while the Laurentide ice had retreated to northern Saskatchewan. Extensive areas of stagnant ice occurred between eastern Alberta and North Dakota. The Laurentide ice cap modified the local weather by being the locus of a high pressure call that caused increased frequencies of upslope weather conditions on the High Plains of Alberta, resulting in enhanced precipitation. This caused expansion of some of the extensive stagnant ice masses to produce the ice advances parallel to the contours across the drainage. As a result, a series of proglacial lakes were developed that lasted until about 8,000 B.P., when the ice cap disintegrated as Hudson Bay opened up. Even then, a subsequent minor readvance occurred.

The Hypsithermal interval on the High Plains of Alberta was warmer than now, but initially the precipitation was very much higher. This resulted in lakes in kettle holes being deeper than today in active alluvial fans at the foot of slopes where no streams presently occur, and in frequent major colluvial events, burying soils at the bases of the valley walls. The presence of Mazama ash in the sediments throughout the area aids in checking the evidence from radiocarbon dates. A single cold spell may have occurred at about 8,800 B.P. producing sorting of gravels as patterned ground at Calgary ...

Shortly after the deposition of the Mazama ash, the climate of the high plains became cooler and drier. These changes were much greater that the climatic fluctuations associated with Neoglacial events.

Abstract : Shortened from Author's Conclusions
Location : IC
Areas : Map areas - 82 H, 82 NE, 83 C, 83 F, 83 SE
Borden areas - DP, EP, FP, FQ
Topics : Analysis of radiocarbon dates, Glacial chronology, Glacial lake sequences, Ice-free corridor

Harris, S.A.

1985 Evidence for the Nature of the Early Holocene Climate and Paleogeography, High Plains, Alberta, Canada. Arctic and Alpine Research 17:49-67.

With the retreat of the Laurentide ice into northern Saskatchewan at about 11,000 BP, upslope weather conditions caused greatly increased precipitation in the Foothills and High Plains. Stagnant ice masses reactivated and expanded; some advanced along the contours, blocking valleys such as that of the Bow River and caused proglacial lakes to form. Glacial Lake Calgary persisted from 11,000 to 8100 BP. Maximum precipitation occurred about 11,000 to 10,000 BP, but enhanced precipitation more than offset the effects of the Hypsithermal interval and persisted until after the deposition of the Mazama ash. Thereafter conditions became drier. The Neoglacial changes were much less marked.

Other geomorphic effects of the wetter conditions were deeper inundation of kettle holes, rapid formation of alluvial fans where streams are not found today, and frequent major colluvial events burying soils at the foot of slopes. A single, short cold spell may have occurred at about 8800 BP, suggesting the effects of the middle phase of the Younger Dryas in the area.

At 11,000 BP, the Foothills and High Plains supported tundra vegetation with subalpine forest at lower elevations. There was an abrupt rise in temperature, and by 10,000 BP, the prairie grasslands had entered the High Plains from the south. After 7000 BP, the grasslands had spread to their maximum extent. A wave of molluscs spread north across the region as the tundra retreated. By 7000 BP these included species whose contiguous distribution today lies well south of Alberta in warmer and more humid areas. The present mammalian fauna had invaded the area by 9500 BP.

Location : AEU, SCI, G 1. A68
Areas : Map areas - 82 H, 82 N, 82 NE, 83 C, 83 F, 83 SE
Borden areas - DP, EP, EQ, FP, FQ
Topics : Analysis of radiocarbon dates, Glacial chronology, Glacial lake sequences, Molluscs, Quaternary stratigraphy, Review of faunal studies, Review of vegetation history, Tephra - Mazama

Harris, S.A., and A.N. Boydell

1972 Glacial History of the Bow River and Red Deer River Areas and the Adjacent Foothills. In Mountain Geomorphology: Geomorphological Processes in the Canadian Cordillera, edited by H.O. Slaymaker and H.J. McPherson, pp. 47-53. British Columbia Geographical Series, Number 14, Tantalus Research, Vancouver.

Abstract : No abstract available
Location : ILL
Areas : Map areas - 82 O, 82 P, 83 A, 83 B
Borden areas - EP, FP
Topics : Glacial chronology

Harris, S.A., and J.D. Howell

1978 Chateau Lake Louise Moraines - Evidence for a New Holocene Event in Southwest Alberta: A Reply. Bulletin of Canadian Petroleum Geology 26:403-407.

Abstract: No abstract available
Location : AEU, SCI, TN 860. A32
AEPAA and ADTMP, Periodicals collection
Areas : Map areas - 82 N, 82 O
Borden areas - EP, EQ
Topics : Glacial chronology, Glacial geomorphology

Harris, S.A., and J.D. Howell
1977 Chateau Lake Louise Moraines - Evidence for a New Holocene Glacial Event in Southwest Alberta. Bulletin of Canadian Petroleum Geology 25:441-445.

Two closely related moraines, often damming up major lakes, occur between 4 and 15 km downstream from the Neoglacial moraines around existing icefields in Banff National Park. These moraines are named the Chateau Lake Louise moraines, after the best known example at Lake Louise. Upstream of them are some of the most beautiful and obvious lakes: e.g., Louise, Hector, Bow, Peyto, Mistaya and Waterfowl. In all cases, the moraines have well-developed soil profiles. The work of Smith (1975) indicates that the early phase of this advance is dated shortly before 8800 radiocarbon years B.P. The moraines appear to represent the last phase of the retreat of the Rocky Mountain glaciers in the area. The equilibrium line altitude was about 210 m lower than today, while ice volume was probably about an order of magnitude less than that required for the Eisenhower Junction advance postulated by Rutter (1972a).

Location : AEU, SCI, TN 860. A32
AEPAA and ADTMP, Periodicals collection
Areas : Map areas - 82 N, 82 O
Borden areas - EP, EQ
Topics : Glacial chronology, Glacial geomorphology

Henoch, W.E.S., B.H. Luckman, and S. Baranowski
1979 A New Holocene Locality from Castleguard Meadows, Banff National Park, Alberta. Zeitschrift für Geomorphologie 23:383-395.

A shallow (0.9 m) section of Holocene deposits from a site on the edge of a ponor in Castleguard Meadows on the flanks of the Columbia Icefield is described. The upper part of the section shows two thick reworked tephra deposits (probably Bridge River Ash c 2600 yr BP and Mazama Ash c 6600 yr BP) separated by a thin organic layer. A second organic layer, 3-6 cm thick, separates the basal tephra from the underlying lacustrine deposits. The C^{14} date of 9600±300 yr BP from the lower organic horizon indicates that the valley was initially deglaciated prior to 10,000 yr BP. The most extensive Holocene glacial advance in the valley occurred during the last few centuries.

Location : AEU, PMC, G 1. Z48 BD 23
Areas : Map areas - 83 C
Borden areas - FQ
Topics : Glacial chronology, Tephra - Mazama, Tephra - Bridge River

Jackson, Jr., L.E.
1987 The Quaternary History of the Calgary Area. In Geology of the Calgary Area, edited by L.E. Jackson, Jr. and M.C. Wilson, pp. 97-107. Canadian Society of Petroleum Geologists, Calgary, Alberta.

Abstract : No abstract available
Location : ILL, ACSP, QE 186.9 J15 1987
Areas : Map areas - 82 NE
Borden areas - EP

Topics : Erratics train, Glacial lake sequences, Quaternary stratigraphy, Review of glacial geomorphology

Jackson, Jr., L.E., G.M. MacDonald, and M.C. Wilson

1982 Paraglacial Origin for Terraced Sediments in Bow Valley, Alberta. Canadian Journal of Earth Sciences 19:2219-2231.

Fluvial terraces flank the course of the Bow River for 100 km from the eastern margin of the Rocky Mountain Front Ranges to Calgary and beyond. The terraces are cut predominantly in gravel fill, which ranges in thickness from approximately 10 m in the Calgary area to 30 m near the mountain front. Sedimentary structures in the gravels indicate a braided stream sedimentary environment in contrast to the present quasi-stable, sinuous, single-channel form of the Bow River. Radiocarbon dates on ungulate remains from the gravels indicates the main period of fill occurred ca. 11 500-10 000 RCYBP (radiocarbon years before present). Previous workers have postulated that the gravels originated directly as outwash from a glacial advance to or beyond the mountain front. The explanation has been refuted by recent stratigraphic and palynologic investigations. A complex nonglaciofluvial origin is proposed for these terraces and the sediments that form them. The last glacial advance to reach the mountain front was well into retreat by as early as ca. 13 400 RCYBP. Spruce and pine forest was established in the Bow River drainage by ca. 10 400-10 000 RCYBP and glaciers were restricted to high cirques. It is probable that the early period of fill deposition (ca. 11 500-10 000 RCYBP) was initiated when mountain tributary trunk streams of the Bow River were choked with debris-flow-delivered sediment during the construction of paraglacial debris fans and related phenomena. The debris flows were distinctive features of early nonglacial times, when landforms left unstable by ice retreat mass-wasted into the valleys. Paraglacial processes explain the early postglacial history of the Bow drainage and this example provides a model readily applicable to other drainages in formerly glaciated terrain.

Location : AEU, SCI, QE 1. C212
AEPAA and ADTMP, Periodicals collection
Areas : Map areas - 82 I, 82 J, 82 O,
Borden areas - EP
Topics : Geomorphology - alluvial sequences, Geomorphology - terraces, Glacial chronology, Paraglacial landforms, Tephra - Mazama

King, R.H.

1986 Weathering of Holocene Airfall Tephras in the Southern Canadian Rockies. In Rates of Chemical Weathering of Rocks and Minerals, edited by S.M. Colman and D.P. Dethier, pp. 239-264. Academic Press, New York.

Abstract : No abstract available.
Location : AEU, SCI, QE 579. R28
Areas : Map areas -82 J, 82 N, 82 O, 83 SW
Borden areas -EP, EQ, FQ
Topics : Soil - clay mineralogy, Soil - chemical properties, Soil - pedogenesis, Soil - physical properties, Tephra - Bridge River, Tephra - Glacier Peak, Tephra - identification, Tephra - Mazama, Tephra - St. Helens

King, R.H.

1984 Quaternary Palesols in the Canadian Rockies and their Significance for Establishing a Chronologic Framework. In Correlation of Quaternary Chronologies, edited by W.C. Mahaney, pp. 243-258. GeoBooks, Norwich, England.

Relict and buried paleosols of Quaternary age are examined at two locations in Banff and Jasper National Parks, Canada. The paleosols contain complex morphologies resulting from the episodic deposition of the various parent materials and the interplay between pedogenesis and paleoenvironmental change. Together, the paleosols provide a recorded synthesis of much that has happened within the major life zones in the Canadian Rockies during the last 10 000 years.

The sequence of deposits at each site and the pedogenic responses to environmental changes can be reconstructed using the physical, chemical and mineralogic characteristics of the paleosols. The Mazama tephra (6700 yr BP) and Bridge River tephra (2350 yr BP) provide a time-stratigraphic framework.

Following deglaciation approximately 10 000 yr BP the local calcareous till was partially decalcified and clay-enriched. The deposition of silty eolian material during the warmer and drier Hypsithermal Interval culminated with the deposition of Mazama tephra. The degradation of this material affected the mineralogical and chemical characteristics of the paleosols, with the development of a clay mineral suite dominated by aluminum hydroxy interlayered vermiculite and amorphous materials. Soil profile complexities were further enhanced by the subsequent deposition of Bridge River tephra. The generally slow rate of eolian deposition, coupled with the climatic deterioration during the Neoglacial has facilitated soil development. Consequently, whilst the paleosols provide a useful record of paleoenvironmental change during the Holocene, any comparison of the degree of development at different locations, based simply on assumed differences in the age of the surfaces, is a fruitless exercise.

Location : AEU, SCI, QE 696. C82
Areas : Map areas -82 N, 83 C
Borden areas -EQ, FQ
Topics : Soil - chemical properties, Soil - clay mineralogy, Soil - pedogenesis, Soil - physical properties, Tephra - Bridge River, Tephra - Mazama

Kostaschuk, R.A., and D.G. Smith

1983 Late Quaternary Lacustrine and Deltaic Sedimentation near Banff, Alberta. Canadian Journal of Earth Sciences 20:1834-1842.

Evidence provided by surface morphology, exposures, cores, and the stratigraphic positions of Mazama (6600 years BP) and Bridge River (2500 years BP) ashes was used to interpret the origin and late Quaternary history of lacustrine and deltaic sediments in the Bow River valley near Banff, Alberta.

There were three distinct stages of Lake Vermilion occupying the study area from Late Pleistocene to mid-Holocene times. The earliest stage was ice dammed, deposited beach gravel and nearshore sand, and drained along the present course of the Cascade River to the east. The second, proglacial stage is associated with thick subsurface deposits of non-organic clay and drained to the east along the course of the modern Bow River. The final stage is suggested by point bar and aeolian beach dune sediments.

With the stabilization of the final stage of Lake Vermilion the low-energy, river-dominated Bow Delta prograded into the lake from the west. Progradation of the delta through three depositional zones produced the present Vermilion Lakes.

Location : AEU, SCI, QE 1. C212
AEPAA and ADTMP, Periodicals collection
Areas : Map areas - 82 O
Borden areas - EP
Topics : Glacial chronology, Glacial lake sequences, Glacial geomorphology, Sedimentology, Tephra - Bridge River, Tephra -Mazama

Leonard, E.M.
1986 **Use of Lacustrine Sedimentary Sequences as Indicators of Holocene Glacial History, Banff National Park, Alberta, Canada.** Quaternary Research 26:218-231.

Bottom sediments from three lakes in the Canadian Rocky Mountains were examined with the aim of evaluating the usefulness of downvalley sediment studies in reconstruction of Holocene glacial histories. Analyses of organic carbon and carbonate contents of core sediments provide information on changing sedimentation rate and changing relative importance of glacial and non-glacial sediment sources. Sedimentary histories of the three lakes are similar, suggesting that they record regional glacial/climatic forcing, rather than localized events, and thus that they may be useful in reconstructing Holocene glacial history. Lacustrine sediments indicate a period of high sedimentation rates and relatively large glacial sediment contribution prior to 7500-7000 yr B.P., with much reduced rates and decreased glacial sediment contribution between about 6000 and 4000 yr B.P., possibly interrupted by a brief period of increased glacial sediment output shortly after 5000 yr B.P. Sometime after 4000 yr B.P., sedimentation rates and glacial sediment output began to rise again, reaching approximately present levels by 2750-2650 yr B.P., and have not since returned to low mid-Holocene levels. In detail over the last 3000 yr there is some indication of a slight decrease in sedimentation rate for more than 1000 yr after about 2200 yr B.P. Sedimentation rates and glacial sediment input into all three lakes rose between about 900 and 750 yr B.P. and have remained very high since. If lake sediments are interpreted as a proxy record of upvalley glacial activity, they allow the development of a glacial chronology which is at once generally consistent with, and more complete and easily datable than, the surficial glacial record.

Location : AEU, SCI, QE 696. Q24
AEPAA, Periodicals collection
Areas : Map areas - 82 N
Borden areas - EQ
Topics : Glacial chronology, Sedimentology, Tephra - Bridge River, Tephra - Mazama

Levson, V., and N.W. Rutter
1986 **A Facies Approach to the Stratigraphic Analysis of Late Wisconsinan Sediments in the Portal Creek Area, Jasper National Park, Alberta.** Géographie physique et Quaternaire 40:129-144.

Glacial diamictons described and sampled during regional stratigraphic studies in Jasper National Park, Alberta, Canada, are categorized using a facies approach. The classification scheme is based on objective field criteria but is designed to ultimately aid in genetic interpretations of the described deposits which are required for meaningful stratigraphic correlations. The utility of the facies approach in solving stratigraphic problems is tested by the analysis of a complex sequence of glacial diamictons in the Portal Creek area. Genetic interpretations placed on the facies were supported by general agreement between theoretical and observed facies sequences, and proved useful in solving stratigraphic problems. Stratigraphic and provenance studies in the Portal Creek region reveal three major sediment packages of distinct provenance indicating that three separate glacial episodes may have occurred. However, an environmental analysis of the deposits shows that the oldest two groups of sediment probably were deposited during the same episode. Changes in till provenance are believed to be the result of fluctuations in the dominance of two confluent glaciers originating in different valleys. The facies analysis supports the stratigraphic evidence that the third sedimentary package was deposited in a distinct glacial episode at a significantly later time than the underlying deposits. Although stratigraphic correlations with dated sediments are tentative, both glacial events recorded in the Portal Creek stratigraphic record are presumed to be Late Wisconsinan in age.

Location : AEU, PMC, G 1. R452
Areas : Map areas - 83 SW
Borden areas - FQ
Topics : Facies studies, Glacial chronology, Quaternary stratigraphy, Till - lithology

Limbird, A.

1986 Genesis of Soils Affected by Discrete Volcanic Ash Inclusions, Alberta, Canada. In Volcanic Soils, edited by E.F. Caldas and D.H. Yaalon, pp. 119-130. Catena, Supplement 7

Soil profiles which include four discrete ash deposits were examined in the Front Range west of Calgary, Alberta. The ashes have been identified as Bridge River (about 2600 years old), St. Helens Y (about 3400 years old), Mazama (about 6600 years old), and Glacier Peak (about 12000 years old). Three of the four ash deposits occupy the positions of, and function in the manner of Ae (E) horizons. Associated with each of these ashes are thin, distinct and strongly structured Bt horizons. The second ash from the surface (St. Helens Y) and the lowest ash (Glacier Peak) have thin Ah horizons associated with them as well, while the surface ash (Bridge River) has an associated litter layer (LFH horizon). The Mazama ash is the only one which does not have an associated soil profile. The area has undergone at least three periods of landscape stability during which soil formation has occurred as indicated by the surface profile and two buried profiles. The dated ashes demonstrate a rate of soil development which has been enhanced markedly by the ashes.

Location : AEU, SCI, S 592.17 V65 C74.
Areas : Map areas - 82 J, 82 O
Borden areas - EP
Topics : Soil - chemical properties, Soil - pedogenesis, Soil - physical properties, Tephra - Bridge River, Tephra - Glacier Peak, Tephra - Mazama, Tephra - St. Helens

Luckman, B.H.
1988 8000 Year Old Wood from the Athabasca Glacier, Alberta. Canadian Journal of Earth Sciences 25:148-151.

Several wood fragments of Pinus sp. (dated at 8230 ± 80 and 8000 ± 90 years BP) and Abies sp. were recovered from the snout of the Athabasca Glacier. This wood, derived from an unknown source up valley, indicates that the glacier was less extensive than at present during the Hypsithermal and that an area up valley of the present snout was tree covered ca. 8000 - 8300 years BP.

Location : AEU, SCI, QE 1. C212
AEPAA and ADTMP Periodicals collection
Areas : Map areas - 83 C
Borden areas - FQ
Topics : Analysis of radiocarbon dates, Holocene timberline fluctuations, Plant macrofossils - wood

Luckman, B.H., M.S. Kearney, R.H King, and A.B. Beaudoin
1986 Revised ^{14}C Age for St. Helens Y Tephra at Tonquin Pass, British Columbia. Canadian Journal of Earth Sciences 23:734-736.

The age of a Mount St. Helens set Y tephra at Tonquin Pass, British Columbia, previously assumed to be 4300 years BP, is revised to ca. 3400 years BP, based on bracketing 14C dates of 3140 ± 80 years BP (Beta 13558) and 3680 ± 80 years BP (Beta 13559). The implications of this revision for tephrostratigraphy of this area are discussed.

Location : AEPAA and ADTMP, Periodicals collection
AEU, SCI, QE 1. C212
Areas : Map areas -83 D
Borden areas -FQ
Topics : Analysis of radiocarbon dates, Tephra - St. Helens

Luckman, B.H., and G.D. Osborn
1979 Holocene Glacier Fluctuations in the Middle Canadian Rocky Mountains. Quaternary Research 11:52-77.

Holocene glacier advances in the Banff-Jasper-Yoho area of the Canadian Rocky Mountains have been extremely limited in extent. Limiting ^{14}C dates from two sites within 1 km of contemporary glaciers or fresh terminal moraines indicate that the late Wisconsin Ice Sheet and valley glaciers disappeared prior to 9660 yr B.P. Two subsequent glacial advances are recognized. The earlier Crowfoot Advance is represented by moraines and rock-glacier deposits overlain by Mazama ash (6600 yr B.P.) and is therefore early Holocene or possible late Wisconsin in age. The late Neoglacial Cavell Advance of the last few centuries is dated by dendrochronology and lichenometry. In addition, there is fragmentary, undated evidence of intermediate-age advance(s), mainly from rock-glacier deposits. All these advances were of limited extent (1-2 km beyond present ice margins) and the Cavell Advance was usually the most extensive. Major exceptions to this pattern occur only where rock glaciers or extensive ice-cored moraines developed during earlier advance(s?). These deposits were not overrun by glaciers during the Cavell Advance because of their relatively greater downvalley extent and the physical barrier they presented to subsequent glacial advances. Earlier work which postulated more extensive early Holocene advances in the Canadian Rocky Mountains is shown to have inadequate dating control: Many of the features previously attributed to older Holocene events are late Wisconsin in age.

Location : AEU, SCI, QE 696. Q24
AEPAA, Periodicals collection
Areas : Map areas - 82 J, 82 N, 82 O, 83 C, 83 D, 83 E, 83 F, British Columbia Rockies
Borden areas - EP, EQ, FQ, region as above
Topics : Dendrochronology, Geomorphology - rock glaciers, Glacial chronology, Lichenometry, Review of glacial history, Tephra - Bridge River, Tephra - Mazama, Tephra - St. Helens

Luckman, B.H., G.D. Osborn, and R.H. King
1978 Chateau Lake Louise Moraines - Evidence for a New Holocene Glacial Event in Southwest Alberta: A Discussion. Bulletin of Canadian Petroleum Geology 26:398-402.

Abstract : No abstract available
Location : AEU, SCI, TN 860. A32
AEPAA and ADTMP, Periodicals collection
Areas : Map areas - 82 N, 82 O
Borden areas - EP, EQ
Topics : Glacial chronology, Glacial geomorphology, Soil - pedogenesis, Tephra - Mazama

McPherson, H.J.
1970 Landforms and Glacial History of the Upper North Saskatchewan Valley, Alberta, Canada. Canadian Geographer 14:10-25.

No clear picture has emerged of the number of glacial advances which occurred in the Canadian Rocky Mountains during the Pleistocene. ...

There is evidence for two major glacial advances in the upper North Saskatchewan River valley. It seems reasonable to assume that the last glacial advance (the Main advance) took place during late Wisconsin time. However, it is not known if the Big Horn advance is Wisconsin or pre-Wisconsin in age.

Clearly until some absolute dates are obtained for the glacial episodes proposed in the individual valleys it would be dangerous to attempt to correlate these events, and to suggest a Pleistocene chronology for the Canadian Rockies.

Several different modes of ice retreat have been proposed for valleys in the Canadian Rockies. ...

In the upper North Saskatchewan valley the landforms from a location near Whirlpool Point to the vicinity of the Cline river appear to have been laid down by a slowly retreating active glacier. Above Whirlpool Point the ice mass retreated more rapidly and large blocks of ice were isolated from the main glacier. These melted in situ to produce local areas of ice-stagnation topography. In the North Saskatchewan valley upstream from Saskatchewan Bridge, the ice retreated in a regular manner with no local stagnation.

Terraces at heights of 18 feet or more above the level of the floodplain were carved in the time span following the formation of the end moraine at Saskatchewan Bridge and approximately 9000 B.P. The lower terraces were cut between 9000 B.P. and the present.

Abstract : Abbreviated from Author's Conclusions
Location : AEU, PMC, G 4. C21
Areas : Map areas - 82 N, 83 C
Borden areas - EQ, FQ
Topics : Glacial chronology, Glacial geomorphology, Till - sedimentary characteristics

Moran, S.R.
1986 Surficial Geology of the Calgary Urban Area. Research Council of Alberta Bulletin 53. (46 pp.)

This study presents the results of mapping of the surficial material in an area of approximately 2985 km^2 with the city of Calgary at its center. The mapping was conducted to determine the distribution and stratigraphic relationships of the surficial materials. ...

The area extends from the foothills in the southwest to the plains in the east. The eroded bedrock surface, with local relief of as much as 200 m, is draped by surficial deposits that range in thickness from less than a metre to more than 85 m. ...

The surficial materials, which were mapped to a depth of 6 m, consist dominantly of loamy to clayey glacial till and clayey to silty glacial lake sediment. Six distinct stratigraphic units have been mapped within the glacial till sequence. The various stratigraphic units within the till sequence are differentiated by both field-recognizable and laboratory determined compositional differences including pebble composition, grain-size, carbonate mineral content, clay mineral composition, and petrology of the very coarse sand.

... Extensive deposits of gravel of Tertiary age cap the Broadcast and Big Hill-Nose Hill uplands beneath a till cover. Other major gravel deposits include as much as 10 m of early Pleistocene gravel covering the floor of the preglacial Bow River valley, and the late Wisconsinan valley floor deposits along the Bow and Elbow Rivers and their major tributaries. ...

The surficial materials in the Calgary area are the products of erosional and depositional activities of rivers, lakes and glaciers acting over a period of several tens of millions of years. During the middle and late Tertiary, rivers flowing out of the mountains eroded the early Tertiary and Cretaceous bedrock, leaving remnants of their gravel-covered valley floors on the major uplands in the area. Erosion continued into the early Pleistocene with the ancestral Bow River cutting its valley nearly to the level of the present valley floor. The gravel deposits of this river are buried beneath the earliest glacial sediment recognized in the area, the weathered pre-Spy Hill till. This till was deposited by a pre-late Wisconsinan glacier that advanced from the mountains to the west. Some time around 25 000 years before present, the late Wisconsinan glaciation began with the advance from the mountains of the Bow Valley glacier, which deposited till of the extensive lower unit of the Spy Hill Formation nearly to the eastern edge of the study area. Before this glacier had completely melted from the area, it was overridden by the continental glacier advancing from the north and northeast. This glacier deposited till of the upper unit of the Spy Hill Formation as far west as Priddis and Cochrane, and the lower part of the Lochend Formation in the eastern part of the area. A series of lakes formed where rivers from the mountains and meltwater from the glacier were dammed by ice. As the ice margin wasted back towards the east exposing progressively lower outlets, the lakes dropped and the Bow and Elbow rivers cut their valleys nearly to their present levels, depositing and then re-eroding gravel at each level. There is evidence of at least one minor readvance of the glacier margin during this period of retreat. The continental glacier wasted completely out of the study area for an unknown period of time, perhaps several thousand years, before readvancing to deposit the till of the Balzac and Crossfield Formations in the eastern and northeastern parts of the area. The same pattern of lakes in the major ice-dammed valleys, with successively lower levels controlled by the wasting glacier, characterized the final deglaciation of the Calgary area. The Bow River and its tributaries were cut to their present levels while glacier ice still persisted in, or just to the northeast, of the area. The period since deglaciation, which began as much as 13 000 years before present, has been characterized by reworking of the river gravels, deposition of extensive alluvial fans over the gravel along the sides of the valleys through the area, and deposition of as much as 1 m of windblown silt or loess on the uplands east of the Bow River south of the city.

Abstract : Abbreviated from Author's Abstract
Location : ADTMP, QE 186. R4 B8 53
ARC, Bulletin 53
Areas : Map areas - 82 NE
Borden areas - EP
Topics : Glacial chronology, Glacial geomorphology, Glacial lake sequences, Quaternary stratigraphy, Till - chemical

Morgan, A.V.
1969 Lithology of the Erratics Train in the Calgary Area. In Geomorphology: Selected Readings, edited by J.G. Nelson and M.J. Chambers, pp. 165-182. Process and Method in Canadian Geography, Methuen, Toronto.

Abstract: No abstract available
Location : AE, 551.4 NEL
Areas : Map areas - 82 NE
Borden areas - EP
Topics : Erratics train, Glacial chronology, Till - lithology

Mountjoy, E.W.
1958 Jasper Area Alberta, a Source of the Foothills Erratics Train. Journal of the Alberta Society of Petroleum Geologists 6:218-226.

Glacial features and bedrock geology in the Jasper area suggest that the latter was the source and an Athabasca Valley glacier was the transporting agent for the Foothills Erratics Train. It is believed that the former Athabasca glacier extended from its present fronts northwest to Jasper, and then flowed northeast through the Front Ranges via the present Athabasca Valley to the Plains where it was deflected southeast by the Keewatin ice-sheet.

Location : AEU, SCI, TN 860. A32
AEPAA and ADTMP, Periodicals collection
Areas : Map areas - 83 SW
Borden areas - FQ
Topics : Erratics train

Nelson, J.G.

1963 The Origin and Geomorphological Significance of the Morley Flats, Alberta. Bulletin of Canadian Petroleum Geology 11:169-177.

Forty miles west of Calgary, in the Rocky Mountain Foothills are the Morley "Flats". Although much of this area of more than seventy square miles is flat, as befits its name, the area is also crossed by a series of ridges of unusual linearity. The ridges are approximately fifteen to sixty feet high, and several hundred to many hundreds of feet in length. A rather detailed analysis of their form and composition indicates that they were deposited by a stagnant ice sheet which melted in place. This interpretation suggests that, in some areas at least, piedmont ice of alpine origin ablated in the same way as continental ice in western Canada, the Arctic, Quebec and other parts of North America.

Location : AEU, SCI, TN 860. A32
AEPAA and ADTMP, Periodicals collection
Areas : Map areas - 82 O
Borden areas - EP
Topics : Glacial geomorphology

Osborn, G.D.

1977 Episodic Holocene Alluviation in Meltwater Channels near Calgary, Alberta. Canadian Journal of Earth Sciences 14:1515-1520.

Sheetlike layers of sediment consisting of coarse clasts in a fine-grained matrix occur at the bases of steep meltwater-channel slopes north and northwest of Calgary. Individual layers are separated by thin organic horizons which are probably accumulations of water-transported burned organic matter. The deposits are interpreted to be products of a series of unchannelled water-sediment slurries created wherever heavy rains fell on denuded or destroyed grass cover stripping the soil from the steep upper parts of the valley slopes. Fire was most likely responsible for periodically destroying the grass cover. At least 24 erosion-alluviation events occurred in one of the channels in the last 15 000 years. These alluviation events seem to be the main process by which the meltwater channels are being infilled.

Location : AEU, SCI, QE 1. C212
AEPAA and ADTMP, Periodicals collection
Areas : Map areas - 82 O
Borden areas - EP
Topics : Geomorphology - alluvial sequences, Geomorphology - meltwater channels, Tephra - Mazama

Osborn, G., and B.H. Luckman

1988 Holocene Glacier Fluctuations in the Canadian Cordillera (Alberta and British Columbia). Quaternary Science Reviews 7:115-128.

Although the record of Holocene glacier fluctuations in British Columbia and Alberta is still very fragmentary, much recent progress has been made in their study. Dating of end moraines has been supplemented by studies of lateral moraine stratigraphy and dating of glacially-overridden organic matter upstream of end moraines.

Dates from sites close to contemporary glaciers indicate that ice had retreated to about its present limits before 10 ka BP. Prior to deposition of Mazama tephra, a minor pre-Hypsithermal readvance (the "Crowfoot Advance") left deposits in the Rockies and the interior of British Columbia. The earliest known Neoglacial advances occurred 5-6 ka BP in the Coast Mountains and shortly after 4 ka BP in the Rockies. An advance culminating ca. 4-3 ka BP has been reported from Bugaboo Glacier, while evidence of another advance culminating in the period ca. 2.5-1.8 ka BP (the "Tiedemann Advance") is reported from more than one site. Following a recession, the Little Ice Age expansion (the "Cavell Advance") began shortly after 900 BP. This advance culminated in most cases in the 18th or 19th centuries. The Crowfoot, Tiedemann, and Little Ice Age Advances were apparently of roughly the same magnitude. The latter was most extensive in most cases, but at several sites Crowfoot moraines lie slightly farther downvalley than Little Ice Age moraines. During the present century, ice-fronts have generally retreated (particularly rapidly in the period 1920-1950 A.D.), although rates of retreat have decreased in the last three decades and some glaciers have readvanced slightly.

Location : AEPAA, Periodicals collection
AEU, SCI, QE 696. Q245
Areas : Map areas - 82 G, 82 J, 82 K, 82 N, 82 O, 83 SW, British Columbia
Borden areas - DP, EQ, FQ, region as above
Topics : Analysis of radiocarbon dates, Review of glacial chronology, Tephra - Mazama

Reasoner, M.A., and N.W. Rutter
1988 Late Quaternary History of the Lake O'Hara Region, British Columbia - An Evaluation of Sedimentation Rates and Bulk Amino Acid Ratios in Lacustrine Records. Canadian Journal of Earth Sciences 25:1037-1048.

Lake O'Hara (subalpine) and Opabin Lake (alpine) are situated directly adjacent to a high section of the Continental Divide in the central Canadian Rocky Mountains. Core samples recovered from the lakes show a consistent stratigraphy comprising gyttja and underlying inorganic clastic sediments. The gyttja contains Bridge River (2350 years BP) and Mazama (6800 years BP) tephras and is separated from the lower clastic sediments by a sharp, conformable contact. Radiocarbon dates obtained from conifer needles, extracted from directly above the contact, indicate that deglaciation had proceeded upvalley from the O'Hara basin prior to ca. 10 100 years BP. Preliminary palaeobotanical and macrofossil data suggest that a Pinus - Abies forest with lesser Picea was established in the vicinity of Lake O'Hara by this time. Consequently, the minimum age of moraine systems situated downvalley from Lake O'Hara is Late Wisconsinan.

Mean annual sedimentation rates were derived from sediment thickness data from 14 Lake O'Hara and 2 Opabin Lake cores. Averaged total sedimentation rate values from the Lake O'Hara cores are 0.13 mm/year (post-Bridge River), 0.13 mm/year (Mazama - Bridge River) and 0.05 mm/year (11 000 years BP - Mazama). Averaged total sedimentation rate values from the Opabin Lake cores are 0.19 mm/year (post-Bridge River), 0.07 mm/year (Mazama - Bridge River), and 0.06 mm/year (8530 years BP - Mazama). Higher total sedimentation rates in post-Bridge River sediments of Opabin Lake are presumably related to climatic conditions associated with more extensive upvalley ice during the last ca. 2300 years. Highly variable sedimentation rate data obtained from the Lake O'Hara cores suggest that the use of sedimentation rate data as a proxy record of upvalley glacial activity is inappropriate in the Lake O'Hara setting where inflowing glacial stream systems are interrupted by upvalley lake basins.

Aspartic acid D/L ratios were derived from bulk gyttja samples of known age from seven Lake O'Hara and one Opabin Lake core. In all but two cases, aspartic acid D/L ratios increase consistently with respect to sediment age. The increasing downcore trends in the aspartic acid D/L ratios suggest the possibility of using amino acid data from bulk gyttja samples as a check for reworking in cases where chronostratigraphic markers are absent.

Location : AEU, SCI, QE 1. C212
AEPAA and ADTMP, Periodicals collection
Areas : Map areas - British Columbia - Yoho National Park
Borden areas - region as above
Topics : Amino acid dating, Neoglaciation, Plant macrofossils - needles, Tephra - Bridge River, Tephra - Mazama, Tephra - St. Helens,

Roed, M.A.
1975 Cordilleran and Laurentide Multiple Glaciation West-central Alberta, Canada. Canadian Journal of Earth Sciences 12:1493-1515.

Informal rock stratigraphic units have been established for the area. They consist of the Marlboro, Raven Creek, Obed, and Drystone Creek tills of Cordilleran provenance, and the Marsh Creek, Edson, and Mayberne tills of Canadian Shield of Laurentide source. Three different gravel units of Tertiary-Quaternary age underlie glacial deposits of the area and are here called the Tableland, Lowland, and Buried Valley gravel, in order of decreasing age.

Evidence for four and possibly five glacier advances has been recognized. The oldest is inferred by fragmentary evidence of an "Early" Cordilleran till. The second, represented by the Marsh Creek till, is the initial and greatest advance of Laurentide ice into the area. In the third both Cordilleran and Laurentide glaciers advanced and met. The Cordilleran ice is recorded by the Marlboro and Raven Creek tills, and the Laurentide by the Edson and Mayberne till. The fourth glacial advance is documented by the Obed till of Cordilleran source. The Hinton terraces were formed during retreat of this glacier. The last glacier advance is indicated by the Drystone Creek till present in small valleys at the mountain front.

Although radiocarbon dates are not available, the Marlboro, Obed, and Drystone Creek Cordilleran ice advances may represent the Early, Middle, and Late Stages of the Pinedale Glaciation (classical Wisconsin) of the Rocky Mountain area of the United States of America. Broadly correlative Cordilleran glacial advances occurred in the Banff area and the Williston Lake area of British Columbia.

Location : AEU, SCI, QE 1. C212
AEPAA and ADTMP, Periodicals collection
Areas : Map areas - 83 F
Borden areas - FQ
Topics : Buried valleys, Erratics train, Glacial chronology, Glacial lake sequences, Quaternary stratigraphy, Till - heavy minerals, Till - lithology

Roed, M.A., E.W. Mountjoy, and N.W. Rutter
1967 The Athabasca Valley Erratics Train, Alberta, and Pleistocene Ice Movements Across the Continental Divide. Canadian Journal of Earth Sciences 4:625-632.

The Athabasca Valley Erratics Train contains a variety of low- to medium-grade metamorphic rocks, the most abundant of which is a talcose schist, with lesser amounts of garnet schist and biotite-quartz schist. This erratics train occurs in and west of the

Athabasca Valley west of Edson, Alberta. It is probably a late stage deposit of the same glacier that carried the Erratics Train, Foothills of Alberta. The metamorphic erratics were incorporated into a glacier that originated in the northern part of the Monashee Mountains and Premier Range of British Columbia. The ice movement is also recorded by numerous U-shaped valleys, which extend across the Continental Divide. Thus, during a brief period in late(?) Wisconsin time, the Cordilleran ice in the Rocky Mountains of the Jasper National Park area was partly derived from west of the Continental Divide and the Rocky Mountain Trench. These data agree with the inferred ice movements shown on the 1958 Glacial Map of Canada.

Location : AEU, SCI, QE 1. C212
AEPAA and ADTMP, Periodicals collection
Areas : Map areas - 83 F
Borden areas - FQ
Topics : Erratics train, Glacial chronology

Roed, M.A., and D.G. Wasylyk
1973 Age of Inactive Alluvial Fans - Bow River Valley, Alberta. Canadian Journal of Earth Sciences 10:1834-1840.

Prominent inactive alluvial fans, which characterize parts of the Bow River valley, Banff National Park, Alberta, were deposited in a distinct interval of 'post-glacial' time. The fans were nearly completely formed before Altithermal time 6000 years B.P., as indicated by the occurrence of Mazama ash in the upper part of one of the fan deposits. This information indicates that a large landslide at Johnston Creek occurred within the same interval of time.

Location : AEU, SCI, QE 1. C212
AEPAA and ADTMP, Periodicals collection
Areas : Map areas - 82 O
Borden areas - EP
Topics : Geomorphology - alluvial fans, Paraglacial landforms - alluvial fans, Tephra - Mazama

Rutter, N.W.
1972 Geomorphology and Multiple Glaciation in the Area of Banff, Alberta. Geological Survey of Canada Bulletin 206. (54 pp.)

Glacial deposits, consisting mainly of till and glaciofluvial deposits, indicate three or possibly four, major Wisconsin ice advances. Individual sections contain only limited parts of the total stratigraphic section, tills of two of the respective advances are not lithologically distinctive, and interstadial or interglacial deposits are lacking. Therefore, the stratigraphic succession on which the glacial chronology was based is constructed from many incomplete sections, with considerable reliance on the geomorphology and areal relationships of the deposits.

What is probably the earliest recorded glacial activity in the Banff area has been inferred from outwash underlying till deposited by the Bow Valley advance, although it is possible that this outwash may be associated with the overlying till. Widespread till deposits and breaks in slope at high elevations are the main evidence for the second, or Bow Valley advance, in which the ice extended well out into the Foothills. Ice-contact fluvial deposits, believed to have been originally kame-moraines, indicate at least two intervals of glacier equilibrium during deglaciation. The Canmore advance extended from the vicinity of Banff probably out to the Foothills. This event is recorded by breaks in slope and by discontinuous patches of till over outwash deposited during the retreat of the Bow Valley ice. The fourth advance, the Eisenhower Junction advance, extended roughly as far as Eisenhower Junction. Evidence includes well-preserved ground and lateral moraines, breaks in slope, fresh cirques, and a terminal moraine. That a minor readvance followed is shown by till over ice-contact fluvial deposits laid down during the wastage of the Eisenhower Junction ice. A radiocarbon date of 9330±170 years B.P. (GSC-332), obtained in a nearby area, is correlated with the time of the Eisenhower Junction retreat.

Three stades of the Pinedale glaciation (late Wisconsin) in the northwestern United States are tentatively correlated with the Bow Valley advance, the Canmore advance, and the Eisenhower Junction advance.

The Altithermal interval is suggested by wind-blown material, containing a volcanic ash layer correlated with Mazama ash, overlying glacial deposits.

Location : AEU, SCI, QE 185. A43
AEPAA, 557.1 C16B 206
Areas : Map areas - 82 O
Borden areas - EP
Topics : Glacial chronology, Glacial geomorphology, Quaternary stratigraphy, Till - lithology

Rutter, N.W.
1969 A Late-Pleistocene Glacial Advance, Bow Valley, Alberta, Canada. In Quaternary Geology and Climate, edited by H.E. Wright, Jr., pp. 104-109. Proceedings of the VII INQUA Congress, Volume 16. National Academy of Sciences, Washington.

In the Bow River valley, Banff National Park, Alberta, Canada, evidence indicates a relatively recent glacial advance, probably the last significant glacial event in the area. The glacier originated at the head of the Bow River valley (elevation ±6,600 ft or ±2,000 m) and flowed as far as Eisenhower Junction (approximately 40 miles or 64 km), receiving ice from numerous tributary valleys along its way.

Evidence for the advance is not based on a distinctive till or stratigraphic sequence, but rather on geomorphic criteria and related glacial deposits, such as relatively fresh lateral moraines and cirques, and breaks in slope caused by glacial scouring and side-glacial stream action. The extent of the advance was determined by an end moraine consisting of ice-contact outwash, by the relative development of the post-glacial Bow River and flood plain plus alluvial fans from tributary creeks upstream and downstream from the end moraine, and by the geographic distribution of relatively fresh cirques and glacial troughs.

Evidence is also present for a minor readvance. Air-photograph interpretation and ground reconnaissance indicate that the Eisenhower Junction advance probably was not local but extended throughout much of the Main Ranges subprovince of the Canadian Rocky Mountains.

The minimum age for the advance may be about 9,330±170 years B.P., as dated from charcoal samples collected in a nearby area.

Location : AEU, SCI, QE 696. Q225
Areas : Map areas - 82 O

Borden areas - EP
Topics: Glacial chronology, Glacial geomorphology, Quaternary stratigraphy

Rutter, N.W.
1966 Glacial History of the Bow River Valley, Banff Area, Alberta. *Canadian Alpine Journal* 49:157-173.

Abstract : No abstract available
Location : AEU, PMC, FC 216. C22
Areas : Map areas - 82 N, 82 O
Borden areas - EP, EQ
Topics : Glacial chronology, Glacial geomorphology, Quaternary stratigraphy, Tephra - Mazama

Rutter, N.W.
1966 Multiple Glaciation in the Banff Area, Alberta. *Bulletin of Canadian Petroleum Geology* 14:620-626.

Abstract : No abstract available
Location : AEU, SCI, TN 860. A32
AEPAA and ADTMP, Periodicals collection
Areas : Map areas - 82 O
Borden areas - EP
Topics : Glacial chronology, Quaternary stratigraphy

Rutter, N.W., and J.E. Wyder
1969 *Application of Borehole Stratigraphy in Areas of Mountain Glacial Drift in Alberta, Canada*. Geological Survey of Canada Paper 69-35. (16 pp.)

Presented here are the results of an integrated program of drilling, side-wall sampling, and single-point electro-logging that has been successfully carried out in areas of mountain glacial drift near Canmore and Calgary, in Alberta. The purpose of this program was to obtain stratigraphic information that could not be acquired by conventional observational techniques. To date, reports from most test drilling programs using rotary hydraulic drills have consisted of descriptions of the chips carried to the surface by the drilling mud. Chip samples by themselves do not provide sufficient evidence for the determination of detailed stratigraphy in areas of rapid lateral and vertical changes in lithology, such as Calgary and Canmore. In these areas, side-wall sampling techniques and electro-logs proved to be valuable stratigraphic tools, readily eliminating ambiguities arising from the examination of chip samples alone.

The results of this program were useful in confirming stratigraphic relationships based on previous surface mapping, in extending geological boundaries, in determining the thickness of lithologic units, and in the discovery of new lithologic units.

Location : AEU, SCI, QE 185. C2
Areas : Map areas - 82 O
Borden areas - EP
Topics : Drilling, Quaternary stratigraphy

Shaw, J.
1988 Discussion: Coarse-grained Sediment Flow Facies in a Large Supraglacial Lake. Sedimentology 35:527-529.

Abstract : No abstract available
Location : AEU, SCI, QE 581. A154
Areas : Map areas - 82 O
Borden areas - EP
Topics : Paraglacial processes, Sedimentology - debris flows, Sedimentology - processes

Shaw, J.
1972 Pleistocene Chronology and Geomorphology of the Rocky Mountains in South and Central Alberta. In Mountain Geomorphology: Geomorphological Processes in the Canadian Cordillera, edited by H.O. Slaymaker and H.J. McPherson, pp. 37-45. British Columbia Geographical Series, Number 14. Tantalus Research, Vancouver.

Abstract : No abstract available
Location : ILL
Areas : Map areas - 82 G, 82 H, 82 N, 82 NE, 83 SW
Borden areas - DP, EP, EQ, FQ
Topics : Glacial chronology, Glacial geomorphology, Review of glacial history

Stalker, A. MacS.
1968 Geology of the Terraces at Cochrane, Alberta. Canadian Journal of Earth Sciences 5:1455-1466.

The prominent terraces north of Bow River at Cochrane, Alberta, divide readily into an upper and a lower set. The three terraces of the upper set represent deltas built into lakes ponded in front of Laurentide ice. They were constructed between 19 000 and 15 000 years ago, when Classical Wisconsin glaciation was near its maximum. Due to the inhospitable conditions then prevailing, these upper terraces contain few or no fossils. During a warm interstade that followed, the glaciers shrank and Bow River deepened and enlarged its valley until ice readvance, about 12 000 years ago, stopped this phase of erosion. Before the glaciers in the Bow and its tributary valleys again retreated, more than 10 000 years ago, Bow River had deposited vast quantities of fill in its valley. Since then, the river has carved the five lower terraces from that fill and from the underlying bedrock.

The valley fill is here named the "Bighill Creek Formation". It is a valuable source of gravel and sand, and a prolific supplier of vertebrate fossils. Most of the latter come from a sand unit, here called the "Clarke Pit Member", which extends throughout much of the formation. Radiocarbon dates indicate that the member is about 11 000 years old.

Location : AEU, SCI, QE 1. C212
AEPAA and ADTMP, Periodicals collection
Areas : Map areas - 82 O
Borden areas - EP
Topics : Faunal remains, Geomorphology - alluvial sequences, Geomorphology - terraces, Glacial chronology, Glacial geomorphology, Quaternary stratigraphy

Stalker, A. MacS., and B.G. Craig

1956 **Use of Indicators in the Determination of Ice-movement Directions in Alberta, Canada: A Discussion. Geological Society of America Bulletin 67:1101-1104.**

Abstract : No abstract available
Location : AEU, SCI, QE 1. G341
ADTMP, Periodicals collection
Areas : Map areas - 82 M, 82 O, 82 P, 83 SE
Borden areas - EO, EP, FP
Topics : Ice movement indicators

Tharin, J.C.

1969 **The Foothills Erratics Train of Alberta, Canada. Michigan Academician 2(2):113-124.**

Abstract : No abstract available.
Location : ILL, ACU
Areas : Map areas -82 H, 82 I, 82 J, 82 O, 83 B, 83 SW
Borden areas -DP, EP, FP, FQ
Topics : Erratics train, Glacial history

Walker, M.J.C.

1973 **The Nature and Origin of a Series of Elongated Ridges in the Morley Flats Area of the Bow Valley, Alberta. Canadian Journal of Earth Sciences 10:1340-1346.**

Recent modifications to the Trans-Canada Highway approximately 65 km west of Calgary, Alberta, exposed deep sections through a series of elliptical ridges. These features had been variously described as moraines, drumlins, and crevasse-fillings. On the basis of field and laboratory evidence, it is concluded that the ridges are drumlins which formed by a process of basal accretion beneath ice of the Bow Valley glacier. Variations in ridge morphology are attributed partly to postdepositional deformation, and partly to dynamic conditions prevailing in the ice at the time of formation.

Location : AEU, SCI, QE 1. C212
AEPAA and ADTMP, Periodicals collection
Areas : Map areas - 82 O
Borden areas - EP
Topics : Glacial geomorphology - drumlins

Westgate, J.A., and A. Dreimanis

1967 **Volcanic Ash Layers of Recent Age at Banff National Park, Alberta, Canada. Canadian Journal of Earth Sciences 4:155-161.**

Three distinctive volcanic ash layers are present in the postglacial sediments at Banff National Park, Alberta. The chemical and mineralogical composition of the ash deposits, together with the radiocarbon age of associated charcoal, indicate the presence of Bridge River ash, whose source area is approximately located in the heart of the southern Coast Mountains, British Columbia, and Mazama ash, derived from Mount Mazama at Crater Lake, Oregon. A maximal age for Bridge River ash is 2 670 ± 140 years B.P. (GSC-531); a minimal age is 2 120 ± 150 years B.P. (GSC-577). Mazama ash is established as being about 6 600 years old, although a slightly younger date of 6 020 ± 90 years B.P. (S-191) was obtained on organic matter associated with this ash at Banff National Park. The source and age of the third ash deposit is not definitely known, but the presence of cummingtonite suggests that it might be St. Helens Y ash, derived from Mount St. Helens, Washington.

Location : AEPAA and ADTMP, Periodicals collection
AEU, SCI, QE 1. C212
Areas : Map areas -82 N, 83 C
Borden areas -EQ, FQ
Topics : Tephra - Bridge River, Tephra - composition, Tephra - Mazama, Tephra - mineralogy, Tephra - St. Helens

Wilson, M.C.

1987 Geological History of the Bow River Valley in the Calgary Region. In Geology of the Calgary Area, edited by L.E. Jackson, Jr., and M.C. Wilson, pp. 109-120. Canadian Society of Petroleum Geologists, Calgary, Alberta.

Abstract : No abstract available
Location : ILL, ACSP, QE 186.9 J15 1987
Areas : Map areas - 82 O
Borden areas - EP
Topics : Faunal remains, Geomorphology - terraces, Glacial chronology, Glacial lake sequences, Paraglacial processes, Quaternary stratigraphy, Tephra - Mazama

Wilson, M.C.

1983 Once Upon a River: Archaeology and Geology of the Bow River Valley at Calgary, Alberta, Canada. National Museum of Man Mercury Series. Archaeological Survey of Canada, Paper No. 114. National Museums of Canada, Ottawa. (464 pp.)

Late Quaternary geology and archaeology of the Bow River Valley at Calgary, Alberta, Canada are considered in terms of archaeological visibility, defined as recognizability of any archaeological manifestations or patterns, in the field or laboratory. Geological factors selectively obscured portions of the record in the west Calgary study area (Bow Valley, Happy Valley Park to Elbow River mouth). Multiple tills suggests at least an interglacial age for the valley. Wisconsin Laurentide ice dammed glacial Lake Calgary, which left silts over 40 m deep. With ice retreat, escaping waters cut spillways across south Calgary and incised the inner Bow Valley through lake deposits, leaving Late Wisconsin or older high terraces. Valley-bottom gravel fill (Bighill Creek Formation) 10,000 to 11,500 yrs old was deposited after the valley was scoured through till to bedrock. Mammuthus sp., Equus conversidens, Camelops cf. hesternus, and Bison bison antiquus were recovered from these gravels at Calgary. Dated Holocene fills record deposition from about 9500-9000 B.P., 8300-5000 B.P., 4700-?3000 B.P., and ?2000-150 B.P. Deposition through the Hypsithermal contrasts with erosion in the southern Plains and shows the danger of extrapolating that sequence too far north. Hypsithermal fill (to T3 filltop) is largely in areas where chutes had been cut into the Bighill Creek Formation T4 fillstrath, away from the Bow channel. The Bow armored its channel and has not cut far enough laterally to reveal many such deposits in cutbanks. The chutes, perhaps with fringing vegetation, were arenas for bison kills; components 8200, 6700, 5400, and 5100 yr old were revealed at the Mona Lisa site (EgPm-3, south city core). Mummy Cave complex projectile points from the two upper kills resemble later point types, indicating a problem of typological visibility added to that of burial away from river cutbanks. These factors account for at least part of the "Altithermal hiatus" in the archaeological record. A black paleosol is pre-Hypsithermal (ca. 9000-8300 B.P.) and other Alberta "Altithermal" soils are possibly of similar age. Mazama ash in alluvial (overbank) and slopewash fan settings is an early Hypsithermal marker; later ashes are obscure, if present. At EgPm-127 (Point Mackay, N.W. Calgary) sedimentary structures (transverse ribs) indicate overbank flow strong enough to have removed all bones. Stone features were partially displaced, flake clusters were apparently not displaced, and bones were removed, reflecting differential entrainment and hence an important visibility constraint. Holocene landscape changes were significant and modern topography is at best a crude guide in site reconstruction. Because cities provide excavated profiles in areas not exposed by natural processes, selective river erosion, mass wasting, and other taphonomically significant processes are partly countered, aiding archaeological visibility. Cities therefore have potential for vigorous prehistoric archaeological programs.

Location : AEPAA, 917.103 N213 #114
Areas : Map areas - 82 I, 82 O, 82 J
Borden areas - EP
Topics : Archaeological sites - EgPm-3, Archaeological sites - EgPm-127, Artifacts, Faunal remains - Bison, Faunal remains - Camelops, Faunal remains - Equus, Faunal remains - Mammuthus, Geomorphology - terraces, Glacial chronology, Palaeosols, Quaternary stratigraphy, Tephra - Mazama

Wilson, M.C. and Hardy, K.J.
1987 The Archaeology of the Calgary Area, Alberta. In Geology of the Calgary Area, edited by L.E. Jackson, Jr. and M.C. Wilson, pp. 97-107. Canadian Society of Petroleum Geologists, Calgary, Alberta.

Abstract : No abstract available
Location : ILL, ACSP, QE 186.9 J15
Areas : Map areas -82 NE
Borden areas -EP
Topics : Archaeological sites - Calgary area, Geoarchaeology, Geomorphology - terraces, Quaternary stratigraphy, Review of archaeological evidence, Tephra - Mazama

d. Northern Western Corridor

Henderson, E.P.

1959 Surficial Geology of the Sturgeon Lake Map Area, Alberta. Geological Survey of Canada Memoir 303. (108 pp.)

The Sturgeon Lake map-area lies in the west part of central Alberta, in the centre of the Peace River country. ...

This report deals with the Pleistocene and Recent deposits within the Sturgeon Lake map-area, together with the associated and derived topographic features. The economic importance of the surficial deposits is considered, as the deposits are the source of engineering material and are the parent material from which the arable soils are derived. ...

During Tertiary time the region underwent long and continued erosion, which produced a mature topography with wide valleys and with gentle slopes extending to the crests of the upland areas. In early Pleistocene time, the initial Cordilleran glaciation to the west of the map-area gave rise to coarse gravels of predominantly quartzitic composition which were laid down on top of bedrock adjacent to the main stream channels. A till which overlies these gravels near the mouth of the Little Smoky River probably represents the first glacial deposition within the area by Laurentide ice from the northeast. This till is of possible Nebraskan or Kansan age.

Following deposition of this first till there were three later invasions of the area by Laurentide ice which left distinct and recognizably different glacial deposits. The oldest of the three tills was deposited by an ice advance during early Wisconsin or, more probably, during pre-Wisconsin time. Above it is another till which forms most of the surface ground moraine in the area. Depth of leaching and amount of erosion indicate it to be early Wisconsin in age. Some kames and outwash sands and gravels are associated with this till.

That a severe periglacial or tundra climate followed is revealed by the development of frost-disturbed features on the previously deposited till, including till mounds which formed on polygonal ground within a network of ice-wedges. The heights of the mounds were accentuated by plastic flow of material following freezing of an active layer over permafrost, with possible removal by solifluction of additional material in the trenches between the mounds.

Following the development of mound swarms, the top till, which is of local extent, was laid down during a stadial readvance in which the ice occupied only the lower parts of the area. The thin top till consisted largely of lacustrine clays and silts laid down in the proglacial lakes that were in the area during much of the ice-free interval that existed prior to its deposition. The presence of these lakes is inferred from, among other things, the unusually high clay content of the youngest till. Water ponded beyond this final ice-tongue deposited stratified silts and clays over the lower parts of the periglacial mound swarms.

As the ice retreated, clays and silts were deposited in ice-choked proglacial lakes. The largest of these, named Lake Falher, was also the youngest and lowest. Varve counts indicate it existed a minimum of 100 to 200 years. After Lake Falher drained, dune formation took place over the parts of its floor where silts and sand predominated. It is possible that the few periglacial mounds in the silt just south of Eaglesham were formed at this time. It is not known whether mound formation continued in the main mound fields at this stage.

Downcutting of the Smoky River valley proceeded steadily throughout post-glacial time except for at least one major interruption when aggradation took place. This period of fluvial deposition by Smoky River was during an expansion of Cordilleran ice over its headwater regions which took place in late Wisconsin time. Trenching of this outwash has left paired terraces along Smoky valley. Other minor terraces along Smoky valley either were due to normal lateral swinging of the stream during downcutting or represent minor checks in stream trenching during short-lived climatic changes.

Thin deposits of alluvium, muck and peat, of small areal extent which were deposited in post-glacial time, are common.

Abstract : Abbreviated from Author's Introduction and Summary of Events in the Area
Location : AEU, SCI, QE 185. A2 No. 303
ADTMP, QE 185. G4 M4 303
Areas : Map areas - 83 N
Borden areas - GQ
Topics : Glacial chronology, Glacial geomorphology, Glacial lake sequences, Loess, Periglacial geomorphology - mounds, Quaternary stratigraphy

Jones, J.F.

1966 **Geology and Groundwater Resources of the Peace River District, Northwestern Alberta. Research Council of Alberta Bulletin 16. (143 pp.)**

This report summarizes geological and groundwater studies carried out over 22,500 square miles of the Peace River region of Alberta between 1957 and 1963.

The bedrock strata with groundwater potential are all Cretaceous in age. ...

Unconsolidated, post-Cretaceous sands and gravels are preserved in buried channels in the region, as near Beaverlodge and High Prairie, and these also form extensive beds between Fairview and Grimshaw. Typically these deposits are overlain by glacial deposits - till, outwash sands and gravels, and the lake silts and clays of the central Peace region. ...

The best potential sources of large groundwater supplies in the Peace River district are the surficial-deposit aquifers. Of these, the buried channel deposits appear to have the best potential for yielding large supplies. It is estimated that the deeply buried channel near High Prairie could yield well over 500 gallons per minute from a single properly constructed well. The course of this channel is as yet largely undetermined but similar yield might be available throughout its length. Buried sands and gravels near Fairview and Beaverlodge also have considerable, but lesser, potential. The Peace River district buried-channel system is, to a large extent, unknown and a complete evaluation of the district's groundwater resources will require a much more detailed knowledge of the system. ...

Abstract : Abbreviated from Author's Abstract
Location : AEU, SCI, QE 186. R415 No. 16
AEPAA, 553.79 J718
ARC, Bulletin 16
Areas : Map areas - 83 M, 83 N, 84 C, 84 D
Borden areas - GQ, HQ
Topics : Bedrock geology, Buried channels, Groundwater resources

Mathews, W.H.

1980 **Retreat of the Last Ice Sheets in Northeastern British Columbia and Adjacent Alberta. Geological Survey of Canada Bulletin 331. (22 pp.)**

The last ice sheets to have covered northeastern British Columbia and adjacent Alberta have left a clear record of their presence and movement in the existing landforms and surficial deposits: grooves and drumlins, meltwater channels, erratics and drift sheets, and traces of former ice dammed lakes. Aerial photograph and map interpretation, supplemented by limited data on surficial materials, has been used to reconstruct the history of the ice retreat.

Three glacier systems were involved: the Laurentide Ice Sheet originating over the Canadian Shield, the Cordilleran Ice Sheet originating in the interior of British Columbia, and a system of valley glaciers from the northern Rocky Mountains (between 57° and 59° N).

At the climax of glaciation all of the area was ice covered, except for high summits and ridges of the northern Rocky Mountains. The earliest exposure of land east of the mountain front between 56° and 60° N was close to the present-day Alaska Highway where relatively high-level lakes and meltwater channels were developed. A series of large lakes, dammed by Laurentide ice, then developed in Peace River valley, with water levels falling as retreating ice exposed lower outlets. The extent of these lakes has been interpreted from the distribution of shorelines, bottom deposits, and tributary and outlet channels. The deposition of Laurentide ice farther north is inferred from ice flow patterns, meltwater channels, and glaciological considerations. The contemporaneous positions of Cordilleran and Rocky Mountain ice fronts, in some stages, can be inferred from the elevation of lakes or of spillways controlled by Laurentide ice. Laurentide ice withdrew more rapidly from the area than did Cordilleran ice, and a late local ice advance from the northern Rocky Mountains is indicated.

Most of the stages of retreat discussed date from about 13 500 to 10 000 years B.P., but the earliest stages may relate to an earlier glaciation.

Location : AEU, SCI, QE 185. A43
AEPAA, 557.1 C16B 331
Areas : Map areas - 83 NW, 84 NW, 84 SW, British Columbia - Northeastern
Borden areas - GQ, HQ, IQ, region as above
Topics : Glacial chronology, Glacial lake sequences, Quaternary stratigraphy

Odynsky, W.
1971 Mounds (Humpies) in the Peace River Area of Alberta. Canadian Journal of Soil Science 51:132-135.

Abstract : No abstract available
Location : AEU, SCI, S 590. C21
ARC, Contribution Series No. 509
Areas : Map areas - 83 M, 83 N
Borden areas - GQ
Topics : Glacial geomorphology - mounds

e. Southeastern Alberta and Southern Saskatchewan

Barendregt, R.W.

1974 Dating Methods of Pleistocene Deposits and their Problems: VI Paleomagnetism. Geoscience Canada 8:56-64.

Paleomagnetism is used in Pleistocene stratigraphic studies as a tool for correlation and relative age dating of equivalent strata or for the absolute dating of deposits. The method is based on the detection of changes in the earth's magnetic field and especially changes of polarity that are recorded by ferromagnetic sediments at the time of deposition.

The study of paleomagnetism as a geophysical dating method began in the 1960s and has grown geometrically since. Instrumentation has greatly improved and the statistical analysis of data, so essential to the proper interpretation of the magnetic record, would not have been possible without computer facilities.

Fine-grained sediments and lava flows are the two media most frequently used. Because reversals have occurred repeatedly in the past, their identification within incomplete sedimentary records is only possible through comparison with other stratigraphic or radiometric data collected for similar or related sedimentary sequences. Continuously deposited marine or terrestrial sediments which show a high sedimentation rate provide isochrons which can be used for worldwide correlation. The recent flourish of research activity into the secular variation of the earth's non-dipole field promises to greatly refine and embellish the geomagnetic time table for the Pleistocene.

Abstract : Author's Summary
Location : AEU, SCI, QE 1. G355
Areas : Map areas - 72 E
Borden areas - DO
Topics : Palaeomagnetism, Review of palaeomagnetic studies, Till - palaeomagnetism

Bik, M.J.J.

1969 The Origin and Age of the Prairie Mounds of Southern Alberta, Canada. Biuletyn Peryglacjalny 19:85-130.

The distribution of prairie mounds in the Foremost-Cypress Hills area in particular and in the area between the Cypress Hills and Edmonton in general, is described and analyzed. Earlier hypotheses of super- or subglacial origin of the prairie mounds do not account for the breaches of the mound rim and cannot explain their occurrence on both glacial and proglacial deposits. A periglacial mechanism of formation is more likely.

In aspect of form the prairie mounds are similar to, but not identical with the collapsed pingos of western Europe. However, there is an excess of material in the former. The low Atterberg limits of the till of the mounds of the Foremost-Cypress Hills area, and the high content in montmorillonite of the clay fraction suggest that subsurface displacement of this material under supersaturated conditions is probable.

The frost-heave potential of the till of the mounds is substantial and ice-lenses of considerable thickness could have formed in it. The parent relief of the mound fields was probably a rolling till plain or lacustrine plain with low internal relief. Under periglacial climatic conditions, ice segregation would start earlier and continue longer below the depressions than beneath the convexities of such a relief, if the till is saturated with water. Below the downwards advancing freezing front supersaturation occurs only when ice segregation has ceased; it ensues earlier under the convexities than beneath the depressions of the parent relief. The "eruption" and subsurface movement of deposits towards the mound sites is explained from the formation of "closed systems" of supersaturated till between an arched permafrost front above and a remnant permafrost layer or a hardrock surface below.

The majority of prairie mounds occurs in belts that regionally run parallel to proglacial lacustrine deposits; these belts appear to be located in the shore-zones of former proglacial lakes. In the Foremost-Cypress Hills area the deposits of a proglacial lake along the margin of which mound fields formed, are less than 20,600 years old. The minimal age of the prairie mounds was determined to be 12,500 years.

Location : AEU, SCI, QE 1. B2 No. 19 1969
Areas : Map areas - 72 E
Borden areas - DO
Topics : Periglacial geomorphology - prairie mounds, Glacial lake sequences, Periglacial processes, Till - physical properties

Bryan, R.B., I.A. Campbell, and A. Yair
1987 Postglacial Geomorphic Development of the Dinosaur Provincial Park Badlands, Alberta. Canadian Journal of Earth Sciences 24:135-146.

Experimental studies concerning current geomorphic processes and erosion rates in the badlands of Dinosaur Provincial Park, Alberta, have not explained the unusual extent of badland development or prominent nonstructural near-horizontal surfaces that occur in the park. Two of these surfaces result from spillway development associated with Wisconsin deglaciation, and the extent of badland development is associated with major spillway concentration and exposure of highly erodible Cretaceous strata. A third surface is associated with erosion caused by locally generated runoff. All surfaces are blanketed with aeolian sands and silts deposited around 5500 BP, which profoundly affected the hydrology of the area and water and sediment discharge from the badlands to the Red Deer River. Subsequent stripping of the aeolian cover by streams, along with piping and tunnel erosion, has reexposed vulnerable Cretaceous strata and restored the high erosion rates now observed in these badlands.

Location : AEU, SCI, QE 1. C212
AEPAA and ADTMP, Periodicals collection
Areas : Map areas - 72 L
Borden areas - EO
Topics : Geomorphology - badlands, Glacial lake sequences, Loess - sedimentary characteristics, Soil - chemical properties, Soil - physical properties

Catto, N.R.
1983 Loess in the Cypress Hills, Alberta, Canada. Canadian Journal of Earth Sciences 20:1159-1167.

Loess deposits in the Cypress Hills were derived from a single, local source located adjacent to the southwestern margin of the plateau. The distributions of sand, clay, and heavy minerals, the changes in thickness of the deposits, and the orientation of the clasts all indicate that the direction of transport was from southwest to northeast. The changes in the textural composition of the loess are reflected in variations in the sorting, with the best sorted material being located in intermediate positions. The loess is depleted in feldspar relative to the source sediments. This depletion is due to the combined effects of weathering of the feldspar to hydrous mica clays and aeolian sorting. The platy clay mineral grains would be less likely to be incorporated into the aeolian load than the spherical and bladed angular quartz grains, and the partially weathered feldspar grains would be similarly preferentially winnowed. The variations noted indicate that loess deposits formed from a single local source will not have uniform textural characteristics, but will vary in texture, sorting, and mineralogy. Similar variations would be expected in continent-wide loess sheets, although the effects of each local source would be masked by the long-distance transport component of the sediment.

Location : AEU, SCI, QE 1. C212
AEPAA and ADTMP, Periodicals collection
Areas : Map areas - 72 E
Borden areas - DO
Topics : Loess - palaeowind direction, Loess - sedimentary characteristics

Christiansen, E.A.
1980 The Wisconsinan Deglaciation of Southern Saskatchewan and Adjacent Areas: Reply. Canadian Journal of Earth Sciences 17:541.

Abstract : No abstract available
Location : AEU, SCI, QE 1. C212
AEPAA and ADTMP, Periodicals collection
Areas : Map areas - Saskatchewan - Southern
Borden areas - region as above
Topics : Quaternary stratigraphy

Christiansen, E.A.
1979 The Wisconsinan Deglaciation of Southern Saskatchewan and Adjacent Areas. Canadian Journal of Earth Sciences 16:913-938.

The Wisconsinan deglaciation of southern Saskatchewan and adjacent areas of Alberta, Manitoba, Montana, and North Dakota is depicted in nine phases of glacial advance, readvance, and retreat. Although there is some uncertainty whether Phase 1 or 2 represents the Classical Wisconsin (Woodfordian) terminus, the glacial history from about 17 000-10 000 is considered.

Although the glacier margin retreated at an increasing rate in Saskatchewan, the volume of meltwater released by the melting glacier decreased with time. The large meltwater channels south of the Cypress Hills as compared to those to the north and the fact that most of the glacial lake deposits north of the Cypress Hills came from extraglacial rivers suggest there was much more glacial meltwater activity south of the Cypress Hills than north of them. This in turn suggests that much of the ice melted before significant retreat of the ice front took place.

Location : AEU, SCI, QE 1. C212
AEPAA and ADTMP, Periodicals collection
Areas : Map areas - Montana - Northern, North Dakota - Northern, Saskatchewan - Central, Saskatchewan - Southern
Borden areas - regions as above

Topics: Glacial chronology, Glacial lake sequences, Quaternary stratigraphy

Christiansen, E.A.
1971 Tills in Southern Saskatchewan, Canada. In Till: A Symposium, edited by R.P. Goldthwait, pp. 167-183. Ohio State University Press, Columbus, Ohio.

Four tills ranging in thickness from one to 250 feet have been recognized and traced in cored and electric-logged testholes for more than 200 miles in southern Saskatchewan. The two older tills (presently unnamed) have been assigned to the Sutherland Group, whereas the younger tills (Floral and Battleford Formations) have been assigned to the Saskatoon Group. The Groups are separated and correlated primarily on the basis of the carbonate content of their till units, the tills of the Saskatoon Group having higher carbonate contents than do tills of the Sutherland Group. Indicators of weathering include oxidation and translocation of gypsum, iron and manganese oxides, and carbonates. The Battleford Formation (youngest till) is Woodfordian and was deposited 12,000 to 20,000 years ago. the increase in carbonate and the decrease in clay in the younger tills is attributed to progressive stripping of Upper Cretaceous clay beds, which progressively decreased the source area for clayey sediments and progressively increased the area of Paleozoic carbonates available for glacial erosion.

Location: AEU, SCI, QE 697. T57
Areas: Map areas - Saskatchewan - Southern
Borden areas - region as above
Topics: Drilling, Quaternary stratigraphy, Till - clay mineralogy, Till - physical properties

Christiansen, E.A.
1968 Pleistocene Stratigraphy of the Saskatoon Area, Saskatchewan, Canada. Canadian Journal of Earth Sciences 5:1167-1173.

Pleistocene sediments in the Saskatoon area are subdivided into the Sutherland and Saskatoon Groups on the basis of dolomite content of tills. The Sutherland Group generally comprises one till, but locally it comprises a lower and upper till. The overlying Saskatoon Group comprises two tills, which are in ascending order the Floral and Battleford Formations.

Forty feet of partial leaching of carbonates in till in the upper part of the Sutherland Group suggests a hiatus of interglacial proportions. The hiatus between the deposition of the Floral and Battleford Formations is Mid-Wisconsin and the Battleford Formation is Woodfordian.

Location: AEU, SCI, QE 1. C212
AEPAA and ADTMP, Periodicals collection
Areas: Map areas - Saskatchewan - Southern
Borden areas - region as above
Topics: Glacial chronology, Quaternary stratigraphy, Till - clay mineralogy, Till - lithology

Christiansen, E.A., and E.K. Sauer

1988 Age of the Frenchman Valley and Associated Drift South of the Cypress Hills, Saskatchewan, Canada. Canadian Journal of Earth Sciences 25:1703-1708

Frenchman Valley extends about 340 km from the Cypress Hills, Saskatchewan, to its confluence with the Milk River in Montana. In one area, the valley is 3 km wide, and it was 180 m deep prior to deposition of as much as 80 m of landslide debris, channel sand and gravel, and alluvial and colluvial deposits. Six radiocarbon ages ranging from 3440 to 11 460 BP suggest the Frenchman Valley is Wisconsinan. The Frenchman Valley could not have formed in its side-hill position if Late Wisconsinan ice had not been present south at the Cypress Hills.

Location : AEU, SCI, QE 1. C212
AEPAA and ADTMP, Periodicals collection
Areas : Map areas - Saskatchewan - Southern
Borden areas - region as above
Topics : Glacial chronology, Quaternary stratigraphy

David, P.P.

1970 Discovery of Mazama Ash in Saskatchewan, Canada. Canadian Journal of Earth Sciences 7:1579-1583.

The first known Mazama ash occurrence in Saskatchewan was discovered in eolian sediments at the top of the bluffs on the South Saskatchewan River valley 20 miles (~32 km) west of Leader, Saskatchewan. The chemical composition and the refractive index of the volcanic glass serve for the definite identification of the Mazama ash. The ash layer is a useful horizon marker in the eolian sediments, for it represents a time-break at 6 600 years ago. It is suggested that eolian deposits in similar sedimentary environments be examined for other occurrences of the Mazama ash.

Location : AEU, SCI, QE 1. C212
AEPAA and ADTMP, Periodicals collection
Areas : Map areas - 72 K
Borden areas - EP
Topics : Tephra - composition, Tephra - Mazama, Tephra - physical characteristics

David, P.P.

1966 The Late-Wisconsin Prelate Ferry Paleosol of Saskatchewan. Canadian Journal of Earth Sciences 3:685-696.

Five occurrences of the Prelate Ferry paleosol are known in exposures in the tributaries of the South Saskatchewan Valley between the Prelate Ferry and Lancer Ferry crossings, in Saskatchewan. At the reference section, 8 mi north of Prelate, Saskatchewan, the paleosol is best developed, and comprises a very dark brown A_{1b} horizon, 12 in. thick; a grey A_{2b} horizon, 7 in.; a dark brown B_{1b} and a lighter B_{2b} horizon, 12 and 19 in. thick respectively; and a C_b horizon, more than 10 in. thick. The paleosol, a planosol or possibly a solodized-solonetz, developed on the lower till and is buried by 120 ft of sediments comprising two till sheets and three beds of stratified drift. The non-glacial Prelate Ferry interval during which the paleosol formed had a local climate similar to that of today. The beginning of the interval is not known, but it ended about 20 000 years ago, when the last major ice advance occurred in the area. Laboratory examinations indicate that the paleosol is pollen-sterile; it shows an upward decrease in grain size; it is weathered, noncalcareous in most parts; it is slightly to strongly alkaline; and it has a clay mineral content similar to that of the underlying till.

Location : AEU, SCI, QE 1. C212 V. 3 1966
AEPAA and ADTMP, Periodicals collection
Areas : Map areas - Saskatchewan - Southern
Borden areas - region as above
Topics : Glacial chronology, Palaeosols, Soil - chemical properties, Soil - physical properties, Till - physical properties

Johnston, W.A., and R.T.D. Wickenden
1931 Moraines and Glacial Lakes in Southern Saskatchewan and Southern Alberta, Canada. Transactions of the Royal Society of Canada, Series 3, Section IV, 25:29-44.

Abstract : No abstract available
Location : AEU, HSS, AS 42. R885
Areas : Map areas - 72 E, 72 L, 72 M, 82 H, 82 I, 82 P, Saskatchewan - Southern
Borden areas - DO, DP, EO, EP, region as above
Topics : Glacial chronology, Glacial lake sequences

Jungerius, P.D.
1969 Age and Origin of the Cypress Hills Plateau Surface in Alberta. In Geomorphology: Selected Readings, edited by J.G. Nelson and M.J. Chambers, pp. 357-371. Process and Method in Canadian Geography, Methuen, Toronto.

Abstract : No abstract available
Location : AE, 551.4 NEL
Areas : Map areas - 72 E
Borden areas - DO
Topics : Glacial chronology, Palaeosols

Jungerius, P.D.
1967 The Influence of Pleistocene Climatic Changes on the Development of the Polygenetic Pediments in the Cypress Hills Area, Alberta. Geographical Bulletin 9:218-231.

The geomorphological history of the unglaciated pediments south of the Cypress Hills plateau is reflected in the materials covering their surface. Deposits and soils formed in an arid or semi-arid environment alternate with solifluction deposits and other periglacial features. The pediments are produced by a combination of pediplanation and cryoplanation.

Location : AEU, SCI, G 1. G36 V9 1967
Areas : Map areas - 72 E
Borden areas - DO

Topics: Geomorphology, Loess - sedimentary characteristics, Soil - physical properties, Till - heavy minerals

Klassen, R.W., and W.J. Vreeken
1987 The Nature and Chronological Implications of Surface Tills and Post-till Sediments in the Cypress Lake Area, Saskatchewan. Current Research, Part A, pp. 111-125. Geological Survey of Canada Paper 87-1A.

Two tills commonly seen in stream cuts and identified in shallow borehole sediments in the Cypress Lake area, Saskatchewan appear to be lodgment and melt-out tills deposited by Late Wisconsinan ice lobes. The suggested till origin has its basis in the following observations: 1) The lower till is compact, jointed, high in clay and local bedrock clasts, whereas the upper unit is looser and contains sand lenses and a higher proportion of erratic clasts. 2) The contact between the tills is typically gradational and lacks evidence of subaerial weathering and biota. 3) The upper unit, typically several metres thick over the till plains, is absent in places and either the lower till or Tertiary gravel forms the surface.

The Late Wisconsinan age is suggested because of the similar nature and thicknesses of post-till sediments studied in back-hoe excavations and boreholes at seven selected sites and several radiocarbon dates obtained at three of the sites. The oldest dates were from two sites in hummocky moraines in the south-central part near the International Boundary where a basal peat dated at ca. 14 ka and shells from a moraine plateau dated at ca. 12 ka.

Location: AEU, SCI, QE 185. C2
Areas: Map areas - 72 F, Saskatchewan - Southern
Borden areas - DO, region as above
Topics: Glacial chronology, Quaternary stratigraphy, Till - lithology

Klassen, R.W., and W.J. Vreeken
1985 Quaternary Geology of Southwestern Saskatchewan. Current Research, Part A, pp. 187-192. Geological Survey of Canada Paper 85-1A.

The unglaciated Cypress and Wood Mountain plateaus and surrounding glaciated terrain in southwestern Saskatchewan reflect significant age differences between not only Tertiary and Quaternary age terrain but within Quaternary age terrain as well. The oldest Quaternary surfaces in the Cypress area are nearly featureless, till-veneered, Tertiary gravel flats similar to the adjacent margin of the unglaciated plateau, whereas the youngest glaciated terrain several hundred metres lower, consists of sharply irregular hummocky terrain. Gently irregular to nearly flat till plains, interspersed with belts of mostly subdued hummocky terrain, occur over the remainder of the area and appear to be of intermediate age.

Absolute age dates have not been obtained from surfaces of Quaternary age in this region. The occurrence of paleosols, volcanic ashes, and fossiliferous sediments within the terrain of intermediate age, however, may provide the age dating control critical to deciphering the Quaternary history of this region.

Location: AEU, SCI, QE 185. C2
Areas: Map areas - 72 F, Saskatchewan - Southern
Borden areas - DO, region as above
Topics: Glacial chronology, Palaeosols, Quaternary stratigraphy

Mahaney, W.C., and A. MacS. Stalker

1988 Stratigraphy of the North Cliff Section, Wellsch Valley Site, Saskatchewan. Canadian Journal of Earth Sciences 25:206-214.

Eight separate till sheets are displayed at the North Cliff, which is part of the Wellsch Valley site in Saskatchewan. Those tills are differentiated by using physical characteristics, particle size, clay and primarily mineralogy, and sediment chemistry. Grain size tends to fine downward in the section, and a significant increase in the mean centre of gravity indicates that some weathering occurred after deposition of the tills. Within the clay mineral suites, smectite tends to dominate in all eight tills, indicating that the paleoclimate was generally as dry as the present-day climate. Only till number 4 (counting from the bottom) contains halloysite; this halloysite may have been entrained from a preweathered surface by the glacier, or it may have formed in situ following deposition. Among the primary minerals, quartz dominates throughout the section, whereas plagioclases are least abundant in tills 4 and 5, possibly as a result of postdepositional weathering. Element composition shows only minor changes for Cu, Pb, Zn, Co, and Ni, whereas Mo increases upward in the section, Cr remains uniform in tills 1, 2, 3, 7, and 8 but increases slightly in tills 4-6, and Mn increases downward, possibly as a response to fluctuating amounts of groundwater. Till 4 forms the best stratigraphic marker in the sequence because of its high Mn content and the presence of halloysite, but till 5 also contains distinctive features in its element composition.

The clay composition of the surface soil, which has formed in the top till since the departure of the last glacier, resembles that found in the underlying tills, whereas quartz and plagioclase are present in lesser amounts. These properties reflect both weathering in a semi-arid climate and the presence of preweathered material from earlier paleosols.

Location : AEU, SCI, QE 1. C212
AEPAA and ADTMP, Periodicals collection
Areas : Map areas - Saskatchewan - Wellsch Valley
Borden areas - region as above
Topics : Geochemistry, Till - geochemistry, Till - lithology, Till - physical properties

Stalker, A. MacS.

1976 Quaternary Stratigraphy of the Southwestern Canadian Prairies. In Quaternary Stratigraphy of North America, edited by W.C. Mahaney, pp. 381-407. Dowden, Hutchinson and Ross, Stroudsburg, Pennsylvania.

Quaternary sections are magnificently displayed along the valleys of the South Saskatchewan River System, in the southwestern Canadian Prairies. These sections, along with vertebrate fossils collected from some 40 sites, have enabled the preparation of a composite stratigraphic column for the Quaternary of the region. This paper deals mostly with the Laurentide part of this column, which is better known than the Cordilleran sequence. The vertebrate paleontology chronology is used, although its use of certain time terms has not, in the past, always corresponded directly with their use by the glacial geologist.

Some deeply weathered Cordilleran till, found near the mountain front, may represent an extensive, early, Cordilleran glaciation. It has not been adequately investigated. In addition, much of the late Pliocene and early Pleistocene Saskatchewan gravels and sands, a unit found beneath the lowest till in buried valleys on the plains, may be outwash from such early Cordilleran glaciers. If so, these tills and gravels give the first indication of Cenozoic glaciation for the region.

The Wellsch Valley Site, north of Swift Current in Saskatchewan, gives the first sign of Laurentide glaciation. Here stones brought by glaciers from the Canadian Shield are found in deposits containing late Blancan and early Irvingtonian vertebrate fossils, and these deposits are probably of Nebraskan or Aftonian age.

At Wascana Creek, near Regina, Pearlette type O ash, with an apparent Kansan age of between 600,000 and 700,000 years, overlies at least two till sheets. The relation of these tills to the four that overlie the fossil bed at Wellsch Valley is unknown; however, the unit containing the ash is probably of much the same age as the Saskatchewan gravels and sands at Medicine Hat, which contain an extensive, late Kansan, vertebrate fauna. As these are the oldest surficial deposits found at Medicine Hat, southern Alberta appears to have escaped the early Laurentide glaciers that covered the Regina - Wellsch Valley region.

At Medicine Hat, after a hiatus of unknown duration, a thick section of silt, sand, and clay was deposited over the Saskatchewan gravels and sands. These stream and pond deposits contain a Yarmouthian vertebrate fauna near their base. They are overlain by tills of Illinoian age, which in turn are overlain by Sangamon alluvium. This alluvium includes the most intensively studied beds at Medicine Hat, and it has produced an abundant, varied and most interesting fauna. Some four Wisconsin tills, separated by beds of sand and gravel, overlie it. The highest of these Wisconsin intertill units contains abundant vertebrate fossils, the bottom unit a more restricted fauna.

Laurentide tills and Cordilleran deposits interfinger west of Lethbridge. Unhappily, Pleistocene vertebrate fossils are rare there, and only a tentative correlation between that section and the Laurentide sequence at Medicine Hat is possible.

Location : AEU, SCI, QE 696. Q25 1976
AEPAA, 551.79097 M277
Areas : Map areas - 72 E, 72 L, 82 G, 82 H, 82 I, 82 J, Saskatchewan - Wellsch Valley
Borden areas - DO, DP, EO, EP, region as above
Topics : Faunal remains, Review of Quaternary stratigraphy, Tephra - Pearlette type O

Stalker, A. MacS.
1969 Quaternary Stratigraphy in Southern Alberta, Report II: Sections Near Medicine Hat. Geological Survey of Canada Paper 69-26. (28 pp.)

This paper continues the detailed description, begun by the author in 1963, of representative Quaternary sections in southern Alberta. It reviews the results of studies at three bluffs - here called Surprise, Mitchell, and Island - located along South Saskatchewan River near Medicine Hat. These three sections were chosen from the large number available in the region because of their many similarities, which suggested the possibility of intercorrelation, and because certain of their beds contain many fossil bones. In addition, one of the beds that is among the most prolific producers of bones also yields stones that appear to have been worked by man. These consist mostly of chert pebbles that have been broken and then chipped along one or more edges.

Although the studies encompassed archeology, vertebrate paleontology, and glacial geology, this report deals chiefly with the glacial geology. However, all the age determinations beyond the range of radiocarbon dating are based on vertebrate paleontology. The beds apparently range from Kansan to Recent in age, and record at least four separate glacier advances and several interglacial or interstadial intervals. Much study was directed to the unit containing the chipped stones. Its abundant fauna indicates deposition during warm, interglacial conditions, probably in Sangamon time. The basal gravels of Kansan Age also contain many bones, as do presumed Mid-Wisconsin deposits found between the topmost two tills. Other beds have yielded bones in lesser numbers.

Location : AEU, SCI, QE 185. C2
AEPAA, 557.1 C16P 69-26
Areas : Map areas - 72 L
Borden areas - EO
Topics : Artifacts, Faunal remains, Molluscs, Quaternary stratigraphy

Stalker, A. MacS., and C.S. Churcher
1972 Glacial Stratigraphy of the Southwestern Canadian Prairies; the Laurentide Record. Proceedings of XXIV International Geological Congress, Montreal, Section 12, 110-119.

Near Medicine Hat, Alberta, surficial deposits ranging in age from mid-Kansan (Blancan- Irvingtonian boundary) to present have been recognized on the basis of vertebrate faunas recovered from several beds. Although the earliest till sheet recorded there is of Illinoian age, there is indirect evidence of nearby glaciation during Yarmouthian time.

At the Wellsch Valley site, Saskatchewan, some 135 miles (220 km) east of Medicine Hat, no ages can be suggested for most of the section, including the four tills. However, vertebrates found in the oldest surficial deposit there, which is a complex mixture of alluvium, pond deposits and slope wash, can be identified to taxa of Blancan or Irvingtonian faunas and thus indicate that this deposit is of Aftonian age. This is substantially older than any of the deposits at Medicine Hat. By joining the lower part of the Wellsch Valley section to the bottom of the Medicine Hat section, a general stratigraphic section covering ?Aftonian to present time is obtained. Though it is sketchy and discontinuous, the chief shortcoming being the non-representation of Cordilleran glaciations, the section does provide a framework to which other deposits on the Canadian Prairies can be correlated.

The lowest unit at the Wellsch Valley site contains stones brought from the Canadian Shield by ice, and so its deposition was preceded by the passage of at least one Laurentide ice sheet, during either the early Aftonian or the Nebraskan faunal stage. For unknown reasons, this ice sheet left no traces at Medicine Hat. The glacial record on the Canadian Prairies thus extends into pre-Aftonian time, and perhaps well beyond 1,500,000 years ago.

Location : AEU, SCI, QE 1. I59
Areas : Map areas - 72 L, Saskatchewan - Wellsch Valley
Borden areas - EO, region as above
Topics : Faunal remains, Quaternary stratigraphy, Tephra - unknown source

Stalker, A. MacS., and J.E. Wyder
1983 Borehole and Outcrop Stratigraphy Compared with Illustrations from the Medicine Hat Area of Alberta. Geological Survey of Canada Bulletin 296. (28 pp.)

This bulletin presents the results of a study that evaluated the relative merits of outcrop and borehole investigations of surficial deposits for stratigraphic purposes and to assist in future interpretations of geophysical logs. Seven boreholes were drilled near thick surficial deposits, each near a previously studied outcrop. The boreholes were logged immediately for self-potential, single point resistivity, natural gamma, porosity and bulk density, and were sampled at selected depths. A composite section for each site was prepared from the outcrop and borehole sequences. In general, the information provided by both outcrop and borehole appeared reliable, and most borehole units were readily identified and correlated with the nearby outcrop.

The results obtained from outcrop and borehole investigations were generally complementary. Information from a borehole is usually superior to that from an outcrop for recording the entire section, determining unit thickness and depth, revealing oxidized zones, and obtaining uncontaminated samples for pollen and carbonate studies. Borehole data are less successful in indicating whether beds of fine material are alluvial, eolian, lacustrine or merely bedrock inclusions, even with the use of samples. The borehole logs neither revealed thin volcanic ash beds and soils nor enabled inclusions in till sheets and duplications of beds from slumping or thrusting to be distinguished from regular bedding. Boreholes are of little value for macro-fossil studies.

The outcrop provided more information about type of material, origin, distribution and continuity of beds; structures, deformation and slumping; and direction of movement of the depositing agent. They were far superior for fabric studies and stone counts, and for collecting large samples for radiocarbon dating or other purposes.

From the borehole logs certain beds were extremely difficult to distinguish from tills. These were mostly mixtures of material, such as alluvium and colluvium laid down and churned by permafrost, and alluvium formed from older, fine lake deposits or bedrock to which stones had been added.

In order to outline stratigraphy accurately, a hole should be logged by as many methods as possible, and abundant samples should be taken.

Location : AEU, SCI, QE 185. A43
Areas : Map areas - 72 L
Borden areas - EO
Topics : Drilling, Quaternary stratigraphy

St-Onge, D.A.
1980 The Wisconsinan Deglaciation of Southern Saskatchewan and Adjacent Areas: Discussion. Canadian Journal of Earth Sciences 17:287-288.

Abstract : No abstract available
Location : AEU, SCI, QE 1. C212
AEPAA and ADTMP, Periodicals collection
Areas : Map areas - 73 D, 73 E, 83 A, 83 G, 83 H, 83 J, 83 K, Saskatchewan - Southern
Borden areas - FO, FP, GP, GQ, region as above
Topics : Glacial chronology, Glacial lake sequences

Szabo, B.J., A. MacS. Stalker, and C.S. Churcher
1973 Uranium-series Ages of Some Quaternary Deposits Near Medicine Hat, Alberta, Canada. Canadian Journal of Earth Sciences 10:1464-1469.

^{230}Th and ^{231}Pa dates were obtained on 10 bone samples from Quaternary deposits near Medicine Hat, Alberta. The youngest date so obtained (9500 ± 1500 years) agrees reasonably well with a radiocarbon date (11 200 ± 200 years) from the same site. In addition, where samples were collected from more than one bed at the same bluff the results are in the correct chronological order. A Sangamon bed containing chipped stones, thought to be artifacts, gave a date of 72 000 ± 6000 years, which is acceptable, though at the younger end of the previously estimated age range of between 200 000 and 70 000 years for the bed.

In general, however, the results reveal large discrepancies with the estimated ages of the beds that yielded the bones. Although several causes for the discrepancies are possible, in two of three instances the uranium series dates themselves appear to be incorrect, and the other dates must be treated with caution.

Location : AEU, SCI, QE 1. C212
AEPAA and ADTMP, Periodicals collection
Areas : Map areas - 72 L
Borden areas - EO
Topics : Uranium-series dates

Teller, J.T., S.R. Moran, and L. Clayton
1980 The Wisconsinan Deglaciation of Southern Saskatchewan and Adjacent Areas: Discussion. Canadian Journal of Earth Sciences 17:539-541.

Abstract : No abstract available
Location : AEU, SCI, QE 1. C212
AEPAA and ADTMP, Periodicals collection
Areas : Map areas - Iowa, Saskatchewan - Southern
Borden areas - regions as above
Topics : Analysis of radiocarbon dates, Quaternary stratigraphy

Vreeken, W.J.
1986 Quaternary Events in the Elkwater Lake Area of Southeastern Alberta. Canadian Journal of Earth Sciences 23:2024-2038.

New data necessitates revisions in the Quaternary chronology of the Elkwater Lake area. Relicts of post-Middle Miocene preglacial erosion surfaces descend to the north and south from the Middle Miocene depositional surface on the Cypress Hills plateau. Both sets of surfaces are marked by oxidized weathering zones, locally culminating in relicts of preglacial paleosols. Both surfaces are overlain by a loess replete with cryogenic imprints. Deposition of this loess with cryogenic imprints shortly predates arrival of the Green Lake glacier at its terminus.

The Green Lake end moraine marks the maximum extent of Laurentide ice in this area. Features previously attributed to the older Elkwater glacier can be explained with reference to proglacial meltwater action associated with the Green Lake glacier. The concept of the Elkwater drift is no longer valid.

Younger loess, called upper loess, mantle nonglaciated terrain and the Green Lake end moraine and began accumulating just before Glacier Peak tephra was deposited (ca. 12 000 years ago). Because there is no evidence of weathering on the Green Lake end moraine beneath the upper loess. Green Lake drift dates from the late Wisconsinan. Most of the upper loess was deposited during the early Holocene and some since the Mazama volcanic eruption, 6600 years ago.

Elkwater Lake reached its highest postglacial level, i.e., at least 6.6 m above the present level, well after the Mazama eruption, before spilling across the Green Lake end moraine into the Ross Creek system. This event irrevocably changed the regimen of Ross Creek, probably to its confluence with the South Saskatchewan River, at Medicine Hat.

Location : AEU, SCI, QE 1. C212
AEPAA and ADTMP, Periodicals collection
Areas : Map areas - 72 E, Saskatchewan - Southern
Borden areas - DO, region as above
Topics : Glacial chronology, Loess - sedimentary characteristics, Palaeosols, Quaternary stratigraphy, Soil - chemical properties, Soil - physical properties, Tephra - Glacier Peak, Tephra - Mazama

Westgate, J.A.
1968 Surficial Geology of the Foremost-Cypress Hills Area, Alberta. Research Council of Alberta Bulletin 22. (121 pp.)

The Foremost-Cypress Hills area is divided into six physiographic units: Cypress Hills Plateau, upland areas, till plains, lacustrine plains, river channels, and canyons. The South Saskatchewan River drains the northern part of the area, and the Milk River drains the southern part. A small internal drainage basin is centred on Lake Pakowki.

Glaciation modified the preglacial physiography of the upland areas to a lesser extent than that of the lower tracts. The preglacial valleys in places contains more than 250 feet of glacial drift. Rivers in the Lethbridge and Medicine Hat Valleys drained the map-area in preglacial times: both occupied broad, open valleys and flowed northeastward.

End moraine, including washboard moraine, is the most widespread glacial land form. Others present include ground moraine, hummocky disintegration moraine, linear disintegration ridges, drumlins and drumlinoid ridges, kames, eskers, and flutings. Proglacial land forms present in the area include outwash aprons, a loess plain, glacial lake basins, meltwater channels, and spillways.

The colour, texture, pebble composition, heavy minerals, and carbonate content in the till matrix of the several till sheets in the map-area were studied. The texture of the tills is largely controlled by the underlying bedrock, and the younger tills generally contain less carbonate pebbles than the older. Preliminary work suggests that heavy minerals are of little value as parameters to differentiate till sheets.

The maximum altitude reached by the Laurentide glaciers in the map-area was about 4500 feet. At this time the ice was at least 2300 feet thick at Medicine Hat, about 1500 feet thick at Foremost and Manyberries and about 1000 feet thick at Aden. The earlier more extensive glaciers moved across the map-area in a southeasterly direction, flowing between the Cypress Hills and the Sweet Grass Hills, which both stood as nunataks. The dominant direction of movement of later less extensive glaciers in the map-area was to the south and southwest, although directions varied considerably near to the ice margin.

The Pleistocene deposits are divided into the following stratigraphic units: Saskatchewan Gravels, Wolf Island sediments, Elkwater drift, Cypress Hills loess, Wild Horse drift, Pakowki drift, Etzikom drift, Oldman drift, and Manyberries volcanic ash. The drift sheets are morphostratigraphic units; each one was deposited at the time of a significant glacial advance. Reliable correlation of subsurface tills with these surface drift sheets is presently not possible because of the sparse number of C-14 dates and limited number of known critical sedimentary parameters.

The Saskatchewan Gravels are defined as those preglacial fluviatile sediments that floor the major preglacial valleys and cover the several alluvial terraces below the erosional surface situated at about 4000 feet above sea level. They lie unconformably upon Upper Cretaceous rocks and are composed predominantly of quartzite pebbles. Wolf Island sediments consist of sands, silts and clays that accumulated in elongate proglacial lakes which formed along the preglacial valleys as a result of downstream damming by Laurentide ice. All drift sheets were deposited by Laurentide glaciers.

The presence of frost action structures and remains of Mammuthus primigenius and Equus sp. definitely indicates a Pleistocene age for the lower (and younger) part of the Saskatchewan Gravels. The uppermost levels of the Saskatchewan Gravels, as defined here, may well be late Tertiary in age. The Elkwater drift is regarded as post-Sangamon, pre-"classical" Wisconsin in age and all of the younger drifts are considered to belong to the "classical" Wisconsin. Manyberries volcanic ash is equivalent to Glacier Peak ash and hence is about 12,000 years old.

No severely weathered horizons have been observed between tills exposed along valley walls. However, two subsurface tills near Lethbridge are greater than 54,500 years old (GSC-237), indicating that tills of early Wisconsin age or older are present in southern Alberta.

Location : AEU, SCI, QE 186. R415
AEPAA, 557.1234 W526S
ADTMP, QE 186. R4 B822
ARC, Bulletin 22
Areas : Map areas - 72 E
Borden areas - DO
Topics: Faunal remains - Equus, Faunal remains - Mammuthus, Glacial chronology, Glacial lake sequences, Quaternary stratigraphy, Quaternary stratigraphy - Saskatchewan gravels and sands, Tephra - Glacier Peak, Till - heavy minerals, Till - lithology

Westgate, J.A., and M.E. Evans

1978 Compositional Variability of Glacier Peak Tephra and its Stratigraphic Significance. Canadian Journal of Earth Sciences 15:1554-1567.

Glacier Peak Volcano erupted many times during the period from ~11000 to ~13000 years ago and produced at least three widespread tephra layers that serve as valuable stratigraphic markers in northwestern United States and the adjacent plains of southwestern Canada. Each of these units can be recognized by their stratigraphic, petrographic, and chemical attributes.

Tephra was shed over eastern Washington, northern Idaho, western Montana, and southernmost Alberta during each of the eruptions responsible for the older two units; the other layer was deposited during the youngest and most violent event that directed tephra to the southeast as far as Yellowstone National Park, ~950 km from the volcano.

Chemical data on glass, hornblende, hypersthene, feldspar, magnetite, and ilmenite show a systematic and unidirectional trend in tephra composition with age; earlier eruptions produced slightly more acidic tephra. The age-composition relationship is confirmed by palaeomagnetic data obtained from 116 specimens collected from two 5 m thick sections. It should therefore be possible to determine the relative age of Glacier Peak tephra samples by their composition alone.

The chronology of the Glacier Peak eruptive sequence is still poorly understood. This is especially true of the oldest unit which has so far only been found in southeastern Alberta. Proximal occurrences should be sought in the bogs of eastern Washington where prospects of preservation and age definition are optimised.

Location : AEU, SCI, QE 1. C212
AEPAA and ADTMP, Periodicals collection
Areas : Map areas - 72 E, Montana, Washington, Wyoming - Yellowstone National Park

Borden areas - DO, regions as above
Topics: Palaeomagnetism, Tephra - composition, Tephra - identification, Tephra - Glacier Peak

f. Central and East-Central Alberta

Babcock, E.A., M.M. Fenton, and L.D. Andriashek
1987 Shear Phenomena in Ice-Thrust Gravels, Central Alberta. Canadian Journal of Earth Sciences 15:277-283.

Pressures exerted by the continental ice sheet produced sheared zones and a pervasive crushing of strong quartzite clasts in preglacial Saskatchewan Gravels of central Alberta. Where deformation is of moderate intensity clasts have fractured at points of impingement with other clasts, and clasts of 3-6 cm in the longest dimension are most likely to be shattered. In zones of intense shear nearly all clasts larger than coarse sand have been crushed and drawn out into lensoid masses.

An index of fracturing was devised to measure the degree of ice pressure induced deformation where the gravels show no evidence of having been disturbed. A model that defines possible conditions at the time of deformation is presented.

Location : AEPAA and ADTMP, Periodicals collection
AEU, SCI, QE 1. C212
Areas : Map Areas - 83 G
Borden areas - FP
Topics : Quaternary stratigraphy - Saskatchewan gravels and sands, Glaciotectonic structures

Bayrock, L.A.
1967 Surficial Geology of the Wainwright Area (East Half), Alberta. Research Council of Alberta Earth Sciences Report 67-4. (10 pp).

The Wainwright area lies within the east-central Alberta Plains, a relatively flat, glaciated area underlain by gently dipping detrital strata of Late Cretaceous age. In most parts of the area, bedrock is overlain by till, as ground or hummocky moraine, the most common type of surficial deposit. Till, in turn, is overlain in many places by glacio-fluvial and lacustrine deposits, aeolian sands, and thin patches of recent alluvium and lacustrine sediments.

Location : AEU, SCI, QE 186. P7 No. 67-004
ARC, Earth Sciences Report 67-4
Areas : Map areas - 73 D
Borden areas - FO
Topics : Quaternary stratigraphy

Bayrock, L.A.
1962 Heavy Minerals in Till of Central Alberta. Journal of the Alberta Society of Petroleum Geologists 10:171-184.

Statistical computations for heavy-mineral analyses of tills from east-central Alberta and the bedrock materials from which they are derived show that these analyses alone are not a suitable criterion for differentiating surface tills, since a large portion of the heavy minerals are derived from the Canadian Shield. The surface till from east-central Alberta was found to contain 81 ± 8 per cent of Cretaceous bedrock materials. It was calculated that on the average about 95 per cent of heavy minerals in the tills came from the Canadian Shield and only about 2 per cent of the transparent heavy minerals in till were derived from Cretaceous deposits.

Location : AEU, SCI, TN 860. A32
AEPAA and ADTMP, Periodicals collection
ARC, Contribution Series 173
Areas : Map areas - 73 D, 73 E, 83 A, 83 H
Borden areas - FO, FP
Topics : Till - heavy minerals

Bayrock, L.A.
1958 Glacial Geology Alliance - Brownfield District, Alberta. Research Council of Alberta Earth Sciences Report 57-2. (43 pp.)

The eastern part of the Alliance-Brownfield district is made up of hummocky dead-ice moraine and the western part is a relatively flat till plain, the Torlea flats (Warren, 1937). Till covers most of the surface of the area, and other glacial and nonglacial deposits comprise only a small fraction of the total. The bedrock of the area is composed of Upper Cretaceous unconsolidated bentonitic shales and sandstones which have a gentle dip to the southwest.

Examination of the glacial land forms in the Alliance-Brownfield district suggests that they were deposited from stagnant ice. Consequently, the origin of glacial deposits and the glacial history is discussed in terms of large-scale downwasting and stagnation of the last glacier which covered the district.

Results of a shallow drilling program and a description of gravel deposits found in this district are given at the end of this report.

Abstract : Part of Author's General Statement
Location : AEU, SCI, QE 186. P7 No. 57-002
ARC, Earth Sciences Report 57-2
Areas : Map areas - 73 D
Borden areas - FO
Topics : Quaternary stratigraphy, Glacial geomorphology

Bayrock, L.A.
1958 Glacial Geology, Galahad-Hardisty District, Alberta. Research Council of Alberta Earth Sciences Report 57-3. (35 pp.)

The Galahad district is made up of flat to gently rolling ground moraine. The topography of the district has been modified by debris-filled meltwater channels - stream trenches - which are numerous in the central portion of the area. The western portion of the Hardisty district is composed of gently rolling ground moraine which has been severely modified by a great number of anastamosing stream-trenches. The central portion of the same district is crossed from north to south by a hummocky dead-ice moraine and the Battle River. The eastern portion of the Hardisty district, including the area surrounding the town of Hardisty, is covered with glacial outwash. East of the hummocky dead-ice moraine the outwash has been modified by wind action and as a result is covered in places with extensive U-shaped dunes.

The glacial deposits of the Galahad-Hardisty district and adjacent districts to the north and south - the Sedgewick and Alliance-Brownfield districts, respectively - were developed from stagnant ice. Hence the glacial history of the Galahad-Hardisty district is interpreted in terms of large scale down-wasting and stagnation of the last glacier to cover the district.

Abstract : Part of Author's General Statement
Location : AEU, SCI, QE 186. P7 No. 57-003
ARC, Earth Sciences Report 57-3
Areas : Map areas - 73 D
Borden areas - FO
Topics : Glacial geomorphology, Quaternary stratigraphy

Bayrock, L.A.

1955 Glacial Geology of an Area in East-Central Alberta. Research Council of Alberta Earth Sciences Report 55-2. (46 pp.)

The Coteau ice advance boundary was mapped in east-central Alberta. The terminal Coteau moraine was found to be located from 10 to 20 miles east of the terminal Coteau ice advance boundary.

Three tills were differentiated in the area: a basal Grey till, the Viking till, and the Coteau till. Mineralogical, mechanical and X-ray analyses performed on the Viking and Coteau tills indicated no major break in the composition of the two tills. The individual soil profiles of the two tills did not reveal any appreciable weathering of silicates in the upper soil horizons, and the depth of leaching of the carbonates appeared very similar and averaged 23 inches.

Based on the laboratory investigations of samples of the Viking and Coteau tills, the conclusion was reached that the time interval separating the two glaciations was quite short.

Location : AEU, SCI, QE 186. P7 No. 55-002
ARC, Earth Sciences Report 55-2
Areas : Map areas - 73 E
Borden areas - FO
Topics : Quaternary stratigraphy, Soil - chemical properties, Till - physical properties

Bayrock, L.A., and G.M. Hughes

1962 Surficial Geology of the Edmonton District, Alberta. Research Council of Alberta Earth Sciences Report 62-6. (40 pp.)

The Edmonton district was glaciated during Wisconsin time by a continental glacier which advanced over the area from the central region of Keewatin. This glacier at the time of maximum extension covered most of Alberta and attained a thickness of about one mile over the map area. The retreat of the glacier from central Alberta was largely by stagnation. As the natural drainage of central Alberta is northeasterly and as the glacier retreated in that same direction, meltwaters were impounded in front of the glacier producing large, relatively short-lived lakes many hundreds of square miles in area. The rapid recession of the stagnating glacier allowed these proglacial lakes to find constantly new and lower outlets. As a result of this, the proglacial lakes in Alberta as a rule have no beaches associated with them.

One such proglacial lake - Lake Edmonton - at one time covered most of the Edmonton district and extended far to the west. Only the very eastern part of the district and a small area in the northwest were not covered by Lake Edmonton; these areas are devoid of lacustrine sediments, the surface deposit being till.

The surface of the lacustrine deposits is for the most part flat, but in places has a very rough topography, a function both of conditions of sedimentation in the lake and of the topography of the underlying materials.

Lake Edmonton was drained finally by the North Saskatchewan River in post-glacial time.

During the Altithermal period, the climate of the area was much warmer and drier than at present. At this time most of the sand dunes in the area were probably formed.

Location : AEU, SCI, QE 186. P7
ARC, Earth Sciences Report 62-6
Areas : Map areas - 83 H
Borden areas - FP
Topics : Glacial lake sequences

Berg, T.E.

1969 Fossil Sand Wedges at Edmonton, Alberta, Canada. Biuletyn Peryglacjalny 19:325-333.

Fossil sand wedges beneath till are present in a sand pit at Edmonton, Alberta, Canada. Climatic implications derived from the wedges are: (1) permafrost was present for at least 400 years and possibly 2400 years prior to ice advance; (2) average annual temperature was at least -5°C or 7°C colder than present; (3) precipitation was less than half of the present precipitation of 40 cm/yr.

Location : AEU, SCI, QE 1. B62
ARC, Contribution Series 398
Areas : Map areas - 83 H
Borden areas - FP
Topics : Periglacial geomorphology - sand wedges

Catto, N.R.

1984 Glacigenic Deposits at the Edmonton Convention Centre, Edmonton, Alberta. Canadian Journal of Earth Sciences 21:1473-1482.

Four main stratigraphic units are present at the Edmonton Convention Centre site in downtown Edmonton. The lowermost sediment exposed is Cretaceous sandstone of the Horseshoe Canyon Formation. This is overlain by preglacial sands and gravels of uncertain age, which contain recumbent drag folds developed by glacial overriding of previously existing periglacial involutions. These sediments are surmounted by a glacigenic complex, consisting of subglacially modified sand and four till facies formed through passive melt out. The uppermost Quaternary sediment present is a proglacial lacustrine unit dominated by silts and clays with interbedded diamictons.

A single glacial episode is recorded in the sediments. Stratigraphic relationships with other exposures throughout the Edmonton region indicate that the glacigenic complex formed during the final ice advance. Variation in the orientation of glacially induced deformations in the preglacial sands and gravels and the basal glacigenic sand indicate that the direction of ice advance was not consistent throughout the final glacial event.

Location : AEU, SCI, QE 1. C212
AEPAA and ADTMP, Periodicals collection
Areas : Map areas - 83 H
Borden areas - FP
Topics : Quaternary stratigraphy, Till - fabric, Till - lithology, Till - heavy minerals

Christiansen, E.A.
1968 A Thin Till in West-Central Saskatchewan, Canada. *Canadian Journal of Earth Sciences* 5:329-336.

A thin till, commonly 1 to 10 ft thick, forms the uppermost till in an area of more than 20 000 square miles in west-central Saskatchewan. The till, named herein the Battleford Formation, is gray to light olive-gray in contrast to the underlying pale olive and pale yellow till and stratified drift. The Battleford Formation was deposited about 20 000 years ago and is separated from the underlying older drift by a disconformity whose hiatus is about 15 000 years. These dates suggest that the weathering interval prior to the deposition of the Battleford Formation is Farmdalian and that the Battleford Formation is Woodfordian.

Location : AEU, SCI, QE 1. C212
AEPAA and ADTMP, Periodicals collection
Areas : Map areas - Saskatchewan - West-Central
Borden areas - region as above
Topics : Glacial chronology, Quaternary stratigraphy, Till - lithology, Till - physical properties

Collins, G.A., and A.G. Swan
1955 *Glacial Geology: St. Anne Area, Alberta*. Research Council of Alberta Report 67. (18 pp.)

Abstract : No abstract available
Location : AEPAA, 551.314 C693
ARC, Uncategorized Report 67
Areas : Map areas - 83 G
Borden areas - FP
Topics : Quaternary stratigraphy

Farvolden, R.N.
1963 Bedrock Topography, Edmonton-Red Deer Map-Area, Alberta. In *Early Contributions to the Groundwater Hydrology of Alberta*, edited by R.N. Farvolden, W.A. Meneley, E.G. Le Breton, D.H. Lennox and P. Meyboom, pp. 57-62. Research Council of Alberta Bulletin 12.

Abstract : No abstract available
Location : AEU, SCI, QE 186. R415 No. 012
ARC, Bulletin 12
Areas : Map areas - 83 A, 83 H
Borden areas - FP
Topics : Bedrock channels

Gravenor, C.P.

1956 **Air Photographs of the Plains Region of Alberta. Research Council of Alberta Earth Sciences Report 56-5. (35 pp.)**

Abstract : No abstract available
Location : AEU, SCI, QE 186. P7 No. 56-005
ARC, Earth Sciences Report 56-5
Areas : Map areas - 72 M, 73 D, 73 E, 74 E, 83 A, 83 M
Borden areas - EO, FO, FP, GQ, HO
Topics : Analysis of air photographs, Glacial geomorphology

Gravenor, C.P.

1956 **Glacial Geology of Castor District, Alberta. Research Council of Alberta Earth Sciences Report 56-2. (23 pp.)**

This presentation of results of a survey of the surficial deposits of the Castor district forms part of a program to map the glacial geology of east-central Alberta.

The Castor district lies within the Torlea flats which is a north-south belt of relatively featureless ground moraine in east-central Alberta. Gently dipping Upper Cretaceous rocks are close to the surface over much of the Torlea flats, and in the Castor district bedrock is exposed in valley walls over much of the southern part of the district and the northwestern part of the district.

The northern part of the Castor district is made up of a relatively flat and featureless till plain. In the southern part of the district the surface till has been largely removed by the action of glacial waters spilling toward the east and southeast out of the Sullivan Lake basin. No evidence of the direction of glacial advance has been found in this district.

Location : AEU, SCI, QE 186. P7 No. 56-002
ARC, Earth Sciences Report 56-2
Areas : Map areas - 73 D
Borden areas - FO
Topics : Quaternary stratigraphy

Gravenor, C.P.

1955 **The Origin and Significance of Prairie Mounds. American Journal of Science 253:475-481.**

Locally, the ground moraine of the western prairies is covered with till mounds. The mounds - which from the air resemble giant doughnuts -average 300 feet in diameter and 15 feet in height, and in most cases have a central depression which lies 3 to 4 feet lower than the outer rim of the mounds. It is believed that the mounds originated as debris-filled pits on a stagnant ice surface and that the melting of the ice left the pit fillings as mounds. The mounds and associated features over parts of western Canada are probably related to slow wastage of the ice in a downslope direction.

Location : AEU, SCI, QE 1. A51
ADTMP, Periodicals collection
Areas : Map are - 72 M, 73 D, 83 A
Borden areas - EO, FO, FP

Topics: Glacial geomorphology - prairie mounds

Gravenor, C.P., and L.A. Bayrock
1956 Stream-Trench Systems in East-Central Alberta. Research Council of Alberta Earth Sciences Report 56-4. (11 pp.)

It has been known for some time that the drainage patterns of Alberta present some abnormal features which are rather difficult to explain by diversions caused by ice advance and retreat, or by the effect of preglacial stream courses (Bretz, 1943 and Warren, 1944). Recently there has been found in the Alliance-Kinsella district of east-central Alberta a confused system of interconnected debris-filled channels which are intimately tied to the drainage problem of the larger stream courses of Alberta. Similar channels - or stream trenches - have been noted on air photographs of the Stettler district, and it seems probable that the conditions which caused the stream-trenches in the Kinsella district were widespread over central Alberta.

The fact that most of the stream-trenches are filled with moraine and stratified materials suggested to the authors that the trenches antedated the last glacial advance. A detailed examination of the Kinsella district, however, has provided evidence to suggest that these debris-filled trenches are contemporaneous with the retreat of the last ice and formed in openings in stagnant ice. The realization of the age of these trenches does much to clarify some of the major problems of drainage in Alberta.

Abstract : Authors' Introduction
Location : AEU, SCI, QE 186. P7 No. 56-004
ARC, Earth Sciences Report 56-4
Areas : Map areas - 73 D
Borden areas - FO
Topics: Quaternary stratigraphy, Drainage systems

Gravenor, C.P., and L.A. Bayrock
1955 Glacial Geology of Coronation District, Alberta. Research Council of Alberta Earth Sciences Report 55-1. (38 pp.)

Much of the Coronation district lies in the Torlea flats, which is a north-south belt of relatively featureless ground moraine in east-central Alberta. Gently dipping Upper Cretaceous bedrock is found quite close to the surface in the Torlea flats and is exposed in the valleys of most of the easterly flowing streams.

The eastern side of the Torlea flats is bounded by the Viking moraine. This broad recessional moraine is made up of a series of segments which trend in a north-south direction north of the Coronation district. Just south of the Coronation district the Viking moraine swings to the east and crosses the Saskatchewan-Alberta border at approximately 52 degrees of latitude.

A large part of this report is devoted to the conditions of retreat of the last ice in this section of Alberta. From the nature of the regional topography and the form of glacial deposits, it is reasoned that the last retreat was marked by large-scale stagnation which proceeded in a down-slope direction.

Abstract : Part of Author's General Statement
Location : AEU, SCI, QE 186. P7 No. 55-001

ARC, Earth Sciences Report 55-1
Areas : Map areas - 73 D
Borden areas - FO
Topics : Quaternary stratigraphy, Glacial geomorphology - moraines

Gravenor, C.P., and R.B. Ellwood
1957 Glacial Geology of Sedgewick District, Alberta. Research Council of Alberta Earth Sciences Report 57-1. (43 pp.)

The western portion of the Sedgewick district of east-central Alberta lies in the Torlea flats, which is a north-south belt of relatively featureless ground moraine in east-central Alberta. A curvilinear band of outwash and ice-contact deposits is found north, northwest and northeast of Sedgewick. This outwash lies in a broad, shallow valley which probably marks the location of a preglacial or interglacial stream course. Wind action on the outwash south and east of Sedgewick has produced faint dune development. Local kames, crevasse fillings and stream-trenches are found on the till plain.

The eastern and northern part of the area is made up primarily of an area of hummocky dead-ice moraine. One of the more spectacular features found in the region is a southeasterly trending system of debris-filled stream-trenches found within the dead-ice moraine. The meltwater which issued from the stream-trenches flooded the south-eastern part of the district and left broad tracts of outwash which cross the valley of the Battle river. Southeast of the Battle river wind action on the outwash has produced longitudinal and U-shaped dunes, some of which are still active.

Flutings found north and east of Sedgewick demonstrate that the ice moved in a southeasterly direction following the course of a preglacial trough. A few miles south of Jarrow, lineations suggest a southwesterly ice-movement direction.

Location : AEU, SCI, QE 186. P7 No. 57-001
ARC, Earth Sciences Report 57-1
Areas : Map areas - 73 D
Borden areas - FO
Topics : Quaternary stratigraphy, Glacial geomorphology

Gravenor, C.P., and B. Ellwood
1956 A Radiocarbon Date from Smoky Lake, Alberta. Research Council of Alberta Earth Sciences Report 56-3. (17 pp.)

While digging a well in November 1954, Mr. J. Kachmar of Smoky Lake, Alberta, struck a log at the 24-foot level. The log was lying in an east-west direction and obstructed Mr. Kachmar's excavation. He chopped out the log and in April 1955 submitted pieces of the wood to the University of Alberta for identification and age-dating. As no radiocarbon age-dating equipment is available in Alberta, the wood was sent to the Physics Department at the University of Manitoba where it was found to be 21,600±900 years B.P.

After the dating a drilling program was carried out by the Research Council of Alberta to verify the stratigraphic sequence given by Mr. Kachmar. Some 34 holes were drilled around the site, using a power-driven auger type drill.

Abstract : Authors' Introduction
Location : AEU, SCI, QE 186. P7 No. 56-003

ARC, Earth Sciences Report 56-3
Areas : Map areas - 83 I
Borden areas - GP
Topics : Analysis of radiocarbon dates, Drilling, Glacial chronology, Plant macrofossils - wood, Quaternary stratigraphy

Gravenor, C. P., and W.O. Kupsch
1959 Ice-Disintegration Features in Western Canada. Journal of Geology 67:48-64.

The wasting Wisconsin glacier left predominantly till deposits in western Canada and only subordinate amounts of stratified drift. In the final phases of wasting, the ice separated in places into a large number of small, dead, ice blocks: it disintegrated. This disintegration caused the preservation of many different land forms, some of which were initiated during the time of ice flow, others originated after flow ceased. Those features that show the influence of the previous live ice are said to be "controlled." Such control may be exerted by crevasses and thrust planes which are the response to stresses operative in a living glacier. Uncontrolled deposits do not reveal the influence of former flow. All gradations between controlled and uncontrolled disintegration can be observed.

The depositional disintegration features include hummocks, moraine plateaus, round and irregularly shaped closed ridges, and washboard moraines. Ice-walled channels are an erosional form. The hummocky terrain and the closed ridges are regarded as the dominant product of uncontrolled disintegration. The linear and washboard ridges developed along inherited lines of weakness in the disintegrating ice and are regarded as controlled disintegration features.

Both uncontrolled and controlled deposits resulted from the sloughing of ablation material into cracks and cavities in the ice and from the squeezing of till upward into openings at the base of the ice.

Location : AEU, SCI, QE 1. J8 V. 67 1959
ARC, Contribution Series 97
Areas : Map areas - 73 D, 73 E, 82 I, Saskatchewan - Central, Saskatchewan - Southern
Borden areas - EP, FO, regions as above
Topics : Glacial geomorphology - ice disintegration features

Gravenor, C.P., and W.A. Meneley
1958 Glacial Flutings in Central and Northern Alberta. American Journal of Science 256:715-728.

An examination of vertical air photographs covering about 175,000 square miles of northern and central Alberta has revealed the presence of large fields of glacial flutings. The flutings show two dominant trends, one in a south to southwest direction and the other in a southeast direction. Although the majority of the flutings are formed in till, in northeastern Alberta the flutings are erosional in character and developed in Precambrian granite gneiss. Striae on the Precambrian flutings are roughly parallel to the ridges. Till fabric determinations made on the southeast flutings of the North Battleford, Saskatchewan district show that there is a marked change in fabric with depth in the ridges. Fluting development apparently bears little relationship to topography. It is believed that the flutings originated from alternating high and low pressure zones at the base of the ice.

Location : AEU, SCI, QE 1. A51 V. 256 1958
ARC, Contribution Series 82
Areas : Map areas - 73 D, 73 E, 73 L, 73 M, 74 D, 74 E, 74 L, 74 M, 83 C, 83 F, 83 NE, 83 NW, 83 SE, 84, Saskatchewan - Central
Borden areas - FO, FP, FQ, GO, GP, GQ, HO, HP, HQ, IO, IP, IQ, region as above
Topics : Glacial geomorphology - flutings, Ice movement indicators, Till - fabric

May, R.W., and S. Thompson

1978 The Geology and Geotechnical Properties of Till and Related Deposits in the Edmonton, Alberta, Area. Canadian Geotechnical Journal 15:362-370.

Deposits of the Quaternary period in the Edmonton area consist of a lower and an upper till, in places separated stratigraphically by a sand, with lacustrine clays, silts and sands overlying this sequence. Detailed field investigations suggest the possible existence of complexities that have not been fully integrated into an understanding of the Quaternary history of the Edmonton area.

The lower till is a moderately stony sandy silt till. In places the upper portion has been reworked or sheared by the ice that deposited the upper till producing a thin zone of slightly lower strength. The upper till is a moderately stony sand till. Regionally it appears to be quite variable lithologically and contains inclusions of sand and gravel; therefore it is more reasonable to think in terms of an upper till unit composed of till and genetically related material. In some localities this upper unit is one single bed of till; in other places, however, it is a layered sequence of paratills, sands, and silts resulting probably from deposition in standing water. The lenses of sand and gravel associated with this unit have caused problems in tunnelling operations and other construction as they contain water, which can cause flooding when encountered during excavation. The paratills known from the examination of outcrops consist of sequences of interbedded till-like material and sands. These sequences are probably the result of turbidite deposition in an ice-marginal lake. These materials would resemble till when enccuntered in drilling operations.

Problems associated with the Quaternary deposits of the Edmonton area include borehole interpretation to develop site stratigraphy, and the determination of geotechnical properties of the deposits and an assessment of their local variation over a specific site. Also of concern are the joints and fractures in the deposits, which affect slope stability and permeability of the soil mass.

An understanding of the Quaternary history and the intrinsic variability of the deposits formed predominantly under the influence of ice is necessary for an understanding of potential sources of variability in geotechnical properties. Interaction between the geologist and the geotechnical engineer can only enhance their mutual comprehension of potential problems and their solutions.

Location : AEU, SCI, TA 710. A1 C2
Areas : Map areas - 83 H
Borden areas - FP
Topics : Drilling, Geotechnical studies, Quaternary stratigraphy, faunal properties

Rains, R.B.

1969 Differentiation of Till Deposits in the Whitemud Creek Valley, Edmonton, Alberta. The Albertan Geographer 5:12-20.

Abstract : No abstract available
Location : AEU, HSS, G 1. A33
Areas : Map areas - 83 H
Borden areas - FP
Topics : Quaternary stratigraphy, Till - fabric, Till - physical properties

Rains, B., and J. Welch

1988 Out-of-phase Holocene Terraces in Part of the North Saskatchewan River Basin, Alberta. Canadian Journal of Earth Sciences 25:454-464.

This study focuses on alluvial terraces in part of the North Saskatchewan River valley, near Edmonton, and in the small tributary valleys of Whitemud and Strawberry creeks. The characteristic terrace morphologies and alluvial sediment sequences are briefly described, but most importantly, the deposits are radiocarbon dated for many sites. Twenty-seven new ^{14}C dates on bone, wood, charcoal, and shell materials, along with previously reported dates, provide the chronological framework for the study. Occurrences of Mazama ash marker bed in terrace alluvium offer additional geochronological evidence. The small tributary valleys have clearly developed in an out-of-phase manner relative to the main river valley, which acts as their local base level. Despite the comparatively abundant geochronological evidence described here, the explanation of alluvial terrace development, in terms of predominant causal factors, remains tantalizingly elusive.

Location : AEU, SCI, QE 1. C212
AEPAA and ADTMP, Periodicals collection
Areas : Map areas - 83 H
Borden areas - FP
Topics : Alluvial sequences, Geomorphology - terraces, Tephra - Mazama

Ramsden, J., and J.A. Westgate

1971 Evidence for a Reorientation of a Till Fabric in the Edmonton Area, Alberta. In Till: A Symposium, edited by R.P. Goldthwait, pp. 335-344. Ohio State University Press, Columbus, Ohio.

Two distinct Pleistocene till units exist in the Edmonton area. The northeasterly provenance of the upper till is indicated by well-developed sole markings and supported by measurements of the orientation of elongate pebbles. Pebbles in the lower till are preferentially oriented, at some places with a northwesterly trend and at other places with a northeasterly trend. The parallelism of the northeasterly preferred trend in the lower till to the basal groove molds and preferred trend of elongate pebbles in the upper till led to the hypothesis that the pebbles of the lower till had been locally oriented by the northeast-southwest movement of the later glacier.

Structural observations support this hypothesis. At all locations where the preferred trend of the long axes of pebbles in the lower till is northeasterly or southwesterly, the till is highly fractured and contains numerous closely spaced shear surfaces, commonly with northeast-southwest lineations. A well-developed shear zone containing slickenslides with northeasterly trends is present at the base of the lower till at many places.

It is suggested (1) that pebbles in the lower till, whose long axes originally were preferentially aligned with a northwesterly or southeasterly trend, have in places been reoriented by the movement of the later glacier so that their long axes now have a preferred trend that parallels the northeast-southwest direction of movement of the later glacier, and (2) that parts of the lower till have been moved en masse by the later glacier. Reorientation appears to have resulted principally from shearing of the till along numerous closely spaced shear planes.

Location : AEU, SCI, QE 697. T57
Areas : Map areas - 83 H
Borden areas - FP
Topics : Ice movement indicators, Till - fabric

Rutherford, R.L.
1937 Saskatchewan Gravels and Sands in Central Alberta. Transactions of the Royal Society of Canada, Section 4, 31:81-95

Location : AEU, HSS, AS 42. R8853
Areas : Map areas - 83 A, 83 G, 83 H
Borden areas - FP
Topics : Quaternary stratigraphy - Saskatchewan gravels and sands

Shaw, J.
1982 Melt-out Till in the Edmonton Area, Alberta, Canada. Canadian Journal of Earth Sciences 19:1548-1569.

Till at two localities in the Edmonton area, Alberta was formed mainly by passive melt-out from glacier ice and not by lodgment by active ice of as a result of supraglacially derived flows. This interpretation is based on the implications of in situ stratified glacial sediment below and within till and of large unlithified clasts of sediment derived from subtill deposits. The interpretation is also supported by more general regional, stratigraphic, and structural observations. Such associated properties as subtill deformation, a sharply planar till-preglacial sediment contact, sole marks, and fabric support formation by melt-out or illustrate local exceptions to this process. Regionally consistent preferred orientation of clasts is interpreted to represent preferred englacial orientation. Collective analysis of the principal eigenvectors of individual englacial fabrics and flow or resedimentation fabrics from a modern glacial environment and similar analysis for till at Villeneuve near Edmonton show the Edmonton till to occupy the intermediate position in terms of orientation strength predicted by the melt-out hypothesis. In places, preferred orientation is considered to have been disturbed by flow and diapirism induced by the process of thaw-consolidation. Thus, preferred clast orientation in till may show considerable deviation from a regional trend. Stratigraphy and sedimentology are used to classify the till and to relate individual exposures to regional environments of deposition.

Location : AEU, SCI, QE 1. C212
AEPAA and ADTMP, Periodicals collection
Areas : Map areas - 83 H
Borden areas - FP

Topics: Quaternary stratigraphy, Till - fabric, Till - genesis

Stalker, A. MacS.

1973 Surficial Geology of the Drumheller Area, Alberta. Geological Survey of Canada Memoir 370. (122 pp.)

The Drumheller area of central Alberta covers about 6,000 square miles directly northeast of Calgary. Although the Rocky Mountain Foothills are nearby, only the most westerly parts of the area were affected by Cordilleran glaciers. Laurentide glaciers, on the other hand, strongly glaciated the whole area several times during the Quaternary Period. Information on early glaciations is scanty as most of the area lies near the drainage divide between Red Deer and Bow Rivers - a region ill-suited for preserving early glacier deposits from destruction by subsequent glaciers. Thick sequences of drift have survived in the preglacial Bow Valley, which crosses the southwestern and southeastern parts of the area, but they are poorly exposed. In the southeast, drift overlies enormous deposits of preglacial (Pliocene and Pleistocene) gravel and sand.

The retreat and the deposits of the Classical Wisconsin glacier are described in detail. The chief feature during the over-all retreat was the Innisfail rejuvenation, which corresponds to one of the Wisconsin stades. During this rejuvenation, the ice thickened at least 500 feet and advanced as much as 125 miles. Most of the spillways in the region developed either during the glacial retreat that immediately preceded this readvance, or during the recession of the still earlier, pre-Classical Wisconsin glacier. They were reoccupied by meltwater streams following the Innisfail Readvance.

Over much of the west half of the area the glacier retreated uphill, retained movement until it had become thin, and was effectively drained. Elsewhere it retreated downhill, stagnated while still fairly thick, and, for the most part, was saturated with water. The result in the western districts was the abundance of esker ridges, ice-flow markings, and spillways, along with extensive areas of till plain and outwash, that form a vivid contrast to the expanses of hummocky moraine and lake plain found in the central and eastern districts.

The term "murdlin" is introduced to designate an elongate ice-flow feature, previously undescribed. A "murdlin" resembles a drumlin both in size and relation to ice movement, but it differs markedly in shape and genesis.

Location: AEU, SCI, QE 185. A2 No. 370
AEPAA, 557.1 C16 370
Areas: Map areas - 82 P
Borden areas - EP
Topics: Glacial chronology, Glacial geomorphology, Glacial lake sequences, Quaternary stratigraphy

Stalker, A. MacS.

1960 Surficial Geology of the Red Deer-Stettler Map-Area, Alberta. Geological Survey of Canada Memoir 306. (140 pp.)

The Red Deer-Stettler area of central Alberta lies near the western limits of the region overrun by the great Laurentide ice-sheets of the Pleistocene epoch. These glaciers were thin during most of their occupation of the area and consequently their movements and effects were strongly influenced by the pre-existing topography. The mantle of various materials left by them has a marked effect on agriculture, water supply, and engineering.

This report deals with the surficial deposits laid down by the glacier, by meltwater from the ice, and by contemporaneous and subsequent action of streams, lakes and wind. It describes the origin and the physiographic forms of these deposits, and stresses the marked effects of ice stagnation. Particular attention is given to gravel deposits, which are listed and described in detail, to the ground-water capabilities of the various surficial materials, and to the fill of the preglacial Red Deer valley which crosses the area. The report also portrays the general regional history during the Pleistocene epoch and, with aid of sketches, details the sequence of events during the final, or Wisconsin, deglaciation of the map-area.

Abstract : Author's Preface
Location : AEU, SCI, QE 185. A2 No. 306
AEPAA, 557.1 C16 306
Areas : Map areas - 83 A
Borden areas - FP
Topics : Glacial chronology, Quaternary stratigraphy

St-Onge, D.A.
1972 Sequence of Glacial Lakes in North Central Alberta. **Geological Survey of Canada Bulletin 213. (16 pp.)**

Information on the glacial history of north-central Alberta has been accumulating since the end of the last century and it is now possible to indicate a series of phases representing the ice frontal positions and the sequence of glacial lakes.

The levels of glacial lakes are determined by the elevations of the deltas and outlets. What was formerly known as Glacial Lake Edmonton is demonstrated to be a series of overlapping lakes controlled by outlets ranging in elevation from 3,200 to about 2,000 feet.

C^{14} dates suggest that ice retreat was relatively rapid and that periglacial conditions do not play an important role in shaping the present relief of north-central Alberta.

Location : AEU, SCI, QE 185. A43
AEPAA, 557.1 C16B 213
Areas : Map areas - 83 F, 83 K, 83 N, 83 NE, 83 SE
Borden areas - FP, FQ, GP, GQ
Topics : Analysis of radiocarbon dates, Glacial lake sequences

Twardy, A.G., S. Pawluk, and J.D. Lindsay
1974 Comparative Study of Four Tills in West-Central Alberta. Canadian Journal of Soil Science 54:69-80.

Twenty-two samples of till representing Ck horizons of soils with very similar morphologies were investigated in west-central Alberta in order to determine the validity for their separation into four separate soil series on the basis of parent material characteristics. Physical, chemical and mineralogical analyses were conducted in order to characterize the tills and determine differences in their lithology, texture, and geochemistry. The data were statistically evaluated using Duncan's new multiple range test. The data indicate that the four tills investigated are statistically separable on the basis of their analytical differences. The Lobley till is characterized by a higher limestone content and higher calcium carbonate equivalent than the other three tills. Amphibole minerals and high grade metamorphic and igneous pebbles were absent in the Lobley till. A greater quantity of total sand, coarse sand

and amphiboles permits the separation of the Cooking Lake till from the other three tills. The Hubalta and Breton tills were found to be somewhat similar in many of their characteristics. However, the Breton till is coarser in texture and contains a greater montmorillonitic component in the clay fraction.

Location : AEU, SCI, S 590. C21
ARC, Contribution Series No. 644
Areas : Map areas - 83 SE
Borden areas - FP
Topics : Till - chemical properties, Till - physical properties, Till - lithology

Warren, P.S.
1954 Some Glacial Features of Central Alberta. Transactions of the Royal Society of Canada, Series 3, Section 4, 48:75-86.

Two tills from the Keewatin area are exposed in many places in southern Alberta and these tills are separated in places by interglacial (interstadial?) beds. The lower till is grey and the upper till a buff or brown colour. These two tills are probably the same as the grey and brown till of the Edmonton area although proof is still lacking. The writer is satisfied that he has identified the grey and brown tills of the Edmonton area as far south as Red Deer River, but cannot trace them through to the exposures on Oldman River in southern Alberta. A third of silt till has not been identified with any certainty farther south than Red Deer River. ...

The age of the three tills of Alberta in terms of glacial stages as defined in the Upper Mississippi valley area is not known. It will probably be a difficult matter to make any exact correlation with that area, based on the amount of weathering or leaching that has taken place since the tills were deposited. Alberta lies largely within the rain shadow of the Rocky Mountains and the climatic conditions in interglacial times were probably similar to those of the present day. A till or moraine in Alberta would have the appearance of being "younger" than one of a similar age in an area of higher temperatures and heavier rainfall. The grey till in central Alberta has the appearance of an old till judged by the character of rocks preserved in it and the amount of induration. The overlying brown till contains some friable rocks such as mica schist and limestone which are usually capable of being crushed by hand. It also weathers to a very solid rock under pressure of overlying lake beds or later till. The silt till has the appearance of a young till. It is completely unconsolidated but this may be due to the lack of sufficient binding material for the high percentage of sand and silt of which it is composed. ...

Abstract : Abbreviated from final section of paper - Age and Correlation of the Central Alberta Tills
Location : ILL, ACM
Areas : Map areas - 73 E, 83 A, 83 G, 83 H
Borden areas - FO, FP
Topics : Glacial chronology, Glacial geomorphology - moraines, Quaternary stratigraphy

Warren, P.S.

1937 The Significance of the Viking Moraine. Transactions of the Royal Canadian Institute No. 46 21(2):301-305.

Abstract : No abstract available
Location : AEU, HSS, AS 42. R88T
Areas : Map areas - 72 L, 72 M, 73 D, 73 E, 83 H, 83 I
Borden areas - DO, EO, FO, FP, GP
Topics : Glacial geomorphology - moraines

Westgate, J.A.

1969 The Quaternary Geology of the Edmonton Area, Alberta. In Pedology and Quaternary Research, edited by S. Pawluk, pp. 129-151. University of Alberta, Edmonton, Alberta.

New data on the Quaternary stratigraphy of the Edmonton area are presented within the geological framework established by other workers.

The oldest Quaternary deposits in the Edmonton area are the fluviatile gravels and sands, known as the Saskatchewan Gravels. These quartzose sediments are found within most of the local bedrock channels; they occur as terrace deposits, up to 15 feet thick, and as valley-fill deposits, in places 60 feet thick. Some of the preglacial uplands are covered by older quartzose gravels. Periglacial structures within the Saskatchewan Gravels, including ice-wedge casts, fossil sand wedges, involutions and once-frozen angular blocks of sand, clearly attest to some horizons accumulating under cold climate conditions.

A grayish-brown, dense clay loam till with some inclusions of stratified sand overlies the Saskatchewan Gravels or sits directly on bedrock. It varies in thickness from 0 to 20 feet, is highly jointed, and possesses some folded joint surfaces. The direction of preferred stone orientation is NW-SE. Stratified sediments, referred to as Tofield Sand, are 40 feet thick in places and commonly separate this lower till from a yellowish brown till. This upper, loamy till has a pronounced columnar structure; the greatest observed thickness is 25 feet. Elongated till stones are preferentially oriented in a NE-SW direction with sole markings indicating ice movement from the NE. Up to 50 feet of well-bedded Lake Edmonton sands, silts, and clays rest on the compact upper till. In some areas, however, deformed stratified beds with lenses of till-like material, interpreted as ablation deposits, immediately underlie the lacustrine sequence.

The North Saskatchewan Valley contains several postglacial alluvial terraces. Little is known about the sedimentary sequence and chronology of the older and higher terraces but the lowermost two developed during the last 10,000 years. Mazama ash is present in the alluvium of the youngest terrace.

Mammalian remains from the youngest beds of the Saskatchewan Gravels suggest that the entire glacial succession is of late Pleistocene age.

Location : AEU, SCI, S 590. P37
AEPAA, 551.79 P342
Areas : Map areas - 83 H
Borden areas - FP
Topics : Geomorphology - terraces, Glacial chronology, Ice movement indicators, Quaternary stratigraphy, Quaternary stratigraphy - Saskatchewan gravels and sands, Tephra - Mazama, Till - fabric

Westgate, J.A., and L.A. Bayrock

1964 Periglacial Structures in the Saskatchewan Gravels and Sands of Central Alberta, Canada. Journal of Geology 72:641-647.

The Saskatchewan gravels and sands are composed dominantly of quartzitic sandstones, chert, and arkosic sandstones, together with a few fragments of basic volcanic rock, limestone and bedrock of local derivation. They have been recognized widely throughout the plains of western Canada and northwestern United States, everywhere lying unconformably upon bedrock and invariably being covered by glacial drift. Ages from late Tertiary to early Pleistocene have been suggested for these gravels and sands.

Near Edmonton, Alberta, temporary exposures in a gravel pit revealed structures in the Saskatchewan gravels and sands that are attributed to deformation by frost action. These structures are: (1) a zone of deranged pebbles, (2) involutions, and (3) fossil ice wedges, now full of sand.

The conclusions drawn from this study are: (1) a periglacial climate existed in central Alberta before the arrival of the Keewatin ice that deposited the Wisconsin till; (2) the Saskatchewan gravels and sands discussed here were deposited in a periglacial environment; and (3) these gravels and sands are older than the "classical Wisconsin" but they are certainly of Pleistocene age.

Location : AEU, SCI, QE 1. J8
ARC, Contribution Series 259
Areas : Map areas - 83 H
Borden areas - FP
Topics : Periglacial geomorphology, Quaternary stratigraphy - Saskatchewan gravels and sands

Westgate, J.A., D.G.W. Smith and H. Nichols

1969 Late Quaternary Pyroclastic Layers in the Edmonton Area, Alberta. In Pedology and Quaternary Research, edited by S. Pawluk, pp. 179-186. University of Alberta, Edmonton, Alberta.

Two late Quaternary pyroclastic layers have been identified in the Edmonton area, Alberta. The composition of the volcanic glass as determined with an electron microprobe, mineralogy, and maximal and minimal radiocarbon dates of 6,630±200 years B.P. and 6,290±250 years B.P. respectively, conclusively demonstrate the presence of Mazama ash at Edmonton. Similar investigations of an ash deposit in a peat bog near Entwistle, Alberta, indicate a St. Helens-Y identity. Peat at the ash level has a radiocarbon age of 3,550±65 years. These respective localities represent the most distant and northerly occurrences of Mazama and St. Helens-Y ash so far identified.

Location : AEPAA, 551.79 P342
Areas : Map areas - 83 G, 83 H
Borden areas - FP
Topics : Tephra - composition, Tephra - Mazama, Tephra - St. Helens

g. Northern Alberta

Fenton, M.M., and A. Dreimanis
1976 Methods of Stratigraphic Correlation of Till in Central and Western Canada. In Glacial Till, edited by R.F. Legget, pp. 67-82. The Royal Society of Canada, Special Publications, No. 12.

... A number of methods based on stratigraphic position or till properties have been used to [correlate till units], such as: (1) texture; (2) composition - lithological, mineralogical, or geochemical; (3) fabric; (4) colour; (5) weathering characteristics; (6) geophysical response; and (7) geotechnical characteristics. Some methods are widely used while others have been applied in only a few areas, but within a particular area the correlations are generally based on the complementary use of two or more of these methods.

The purpose of this paper is primarily to demonstrate some of these methods utilizing examples from the authors' research in Manitoba, Ontario and Alberta ... and, secondarily, to comment briefly on the methods used by some other researchers.

Abstract : Adapted from part of Authors' opening statement
Location : AEU, SCI, QE 579. G541 1972
Areas : Map areas - 74 D, 74 E, Manitoba - Southeastern, Ontario - Southwestern
Borden areas - HO, regions as above
Topics : Drilling, Till - correlation, Till - fabric, Till - lithology, Till - physical properties

Jones, N.
1980 The Formation of Glacial Flutings in East-Central Alberta. In Glacial, Glaciofluvial and Glaciolacustrine Systems, edited by R. Davidson-Arnott, W. Nickling, and B.D. Fahey, pp. 49-70. 6th Guelph Symposium, Department of Geography, Guelph University.

The Lac la Biche fluting and drumlin field originates at Lac la Biche, Alberta and extends southeastwards almost to North Battleford, Saskatchewan, a distance of approximately 390 km. The southeast orientation of the field is transverse to the regional north-east to south-west ice flow direction in Alberta. The Lac la Biche field appears to be a result of this region, about 11 400 years ago. The purpose of this investigation is to determine the genesis of the glacial landforms in the Lac la Biche field.

Field investigations, including till fabric, texture and lithology, show ubiquitous glacial tectonic activity, implying that frozen-bed conditions and compressive ice flow probably ensued at some point during ice advance. The smooth, streamlined appearance of drumlins and flutings indicates a transgression into wet-bed conditions and, possibly, extending flow. Initial frozen-bed conditions and compressive flow caused glacial thrusting and plucking of blocks of basal debris near the margin of the ice. The blocks lodge at the glacier bed and resist further movement. With continued advance thawed-bed conditions are encountered and deposition in a low pressure zone created in the lee of these obstacles occurs. Lateral transport of debris in the lee of the blocks was accomplished as a result of the presence of converging secondary flow cells, created by the basal pressure gradient. Till fabric analyses show a 'herring bone' fabric pattern, supporting the existence of converging secondary flow.

Auger holes drilled through three flutings, numerous road cut examinations, and subsequent till textural and lithologic analyses, show only one till is present in the streamlined landforms, reducing the validity of any hypothesis which involves the addition of two or more till layers during consecutive ice advances. The complete formation of both the drumlins and flutings was found to have occurred during a single ice advance.

Location : IC
Areas : Map areas - 73 E, 73 L
Borden areas - FO
Topics : Glacial geomorphology - drumlins, Glacial geomorphology - flutings, Ice movement indicators

McKeague, J.A., P.A. Schuppli, and H. Kodama
1986 Glauconite Nodules in a Nampa Pedon from Alberta. Canadian Journal of Earth Sciences 23:432-435.

Nodules 0.1 - 0.7 mm in diameter seen in thin sections of the C horizon of a soil from the Peace River area of Alberta were analyzed. Energy-dispersive X-ray analysis (EDXRA) showed their composition (%) to be approximately MgO, 3; Al_2O_3, 22; SiO_2, 52; K_2O, 4; CaO, 2; Fe_2O_3, 10. X-ray analysis by Gandolfi camera showed strong glauconite lines and weak lines for quartz and kaolinite. The presence of these relatively large glauconite nodules in an otherwise fine-grained material is incompatible with its presumed lacustrine origin. Presumably, the glauconite nodules were inherited from the Smoky River shale, and the C horizon material may be residual.

Location : AEU, SCI, QE 1. C212
AEPAA and ADTMP, Periodicals collection
Areas : Map areas - 83 N
Borden areas - GQ
Topics : Soil - mineralogy, Soil - pedogenesis

Shaw, J., and D. Kvill
1984 A Glaciofluvial Origin for Drumlins of the Livingstone Lake Area, Saskatchewan. Canadian Journal of Earth Sciences 21:1442-1459.

The Livingstone Lake drumlin field of northern Saskatchewan is on the Athabasca Plains. It is draped over high ground underlain by the Precambrian Athabasca Sandstone. The drumlins occur in spindle, parabolic, and transverse asymmetrical forms. A map of individual drumlins shows that features of similar form occur together. The drumlins are related on a regional scale to even larger landforms. There is also an arrangement of drumlins in streams parallel to the assumed flow direction. These patterns illustrate spatial organisation of the drumlin-forming flows. The Livingstone Lake drumlins are closely related to tunnel valleys, large crescentic scours, and eskers. Exposed bedrock reveals widespread scalloping and sichelwannen. An argument is made that drumlins are related to these glaciofluvial forms but were created at different times and by different flows than those forming small-scale flutings and other lodgement features. Sediments within the drumlins are mainly primary water-sorted deposits some of which were resedimented by mass movements. There are also large, striated boulders. Deposition in subglacial cavities is suggested. This explanation is supported by a comparison of patterns and forms of erosional marks produced by wind and water and the implied form of the subglacial cavities. The Livingstone Lake drumlins are considered to represent infillings of cavities developed by meltwater erosion of the underside of glaciers. This conclusion stresses the geomorphic and sedimentologic importance of subglacial meltwater. It has important implications for the

behaviour of the large Pleistocene ice sheets and the interpretation of glacigenic sediments. Consequently, it has direct bearing on glacial stratigraphy and chronology.

Location : AEU, SCI, QE 1. C212
AEPAA and ADTMP, Periodicals collection
Areas : Map areas - Saskatchewan - Northern
Borden areas - region as above
Topics : Glacial geomorphology - drumlins, Ice movement indicators

St-Onge, D.A.
1974 The Geomorphology of the Swan Hills Area, Alberta. Geological Survey of Canada Paper 74-26. (6 pp.)

A detailed geomorphological map (Map 1206A, Geological Survey of Canada) illustrates the complexity of landforms on a portion of the south slopes of the Swan Hills in central Alberta. The major landforms such as the Swan Hills, the "Virginia Hills", and the Freeman River valley are inherited from a preglacial landscape. They consist of a series of gravel-covered benches leading down from the Swan Hills plateau to the alluvial plain of an ancestral Athabasca River valley. Glaciers add little to modify this landscape but meltwater streams carved numerous channels which are now generally covered by extensive bog deposits.

Location : AEU, SCI, QE 185. C2
Areas : Map areas - 83 J
Borden areas - GP
Topics : Geomorphology - general

St-Onge, D.A.
1972 La Stratigraphie du Quaternaire des Environs de Fort-Assiniboine, Alberta, Canada. Revue de Géographie de Montréal 26:153-163.

Numerous cuts, carved by modern streams in their valley sides, make it possible to study the sequence of deposits filling an ancestral valley system in the Fort Assiniboine region. It is thus possible to propose a stratigraphic sequence for the Upper Quaternary of North Central Alberta. Coarse fluvial gravel, apparently devoid of Shield stones, rest on Upper Cretaceous bedrock. Vertebrate fossils suggest that these gravels are of Sangamon age. An early Wisconsin ice advance dammed northeast flowing streams; as a result, large amounts of sand were deposited within the valleys. The till related to this glaciation is characteristically dark colored, prismatic and contains few stones and cobbles. As this ice mass retreated, thick outwash deposits were laid down. Wood fragments found in these sediments are beyond C_{14} age. The Upper till, probably of late Wisconsin age, is a massive stony hardpan. It is covered by an extensive mantle of varved silts and clays deposited in a series of pro-glacial lakes. Rivers flowing into these lakes built up thick series of deltaic sands. Several C_{14} dates make it possible to determine the age of ice retreat from this region.

Location : AEU, PMC, G 1. R45
Areas : Map areas - 83 J
Borden areas - GP
Topics : Faunal remains - Bison, Faunal remains - Equus, Faunal remains - Mammuthus,

Glacial chronology, Plant macrofossils - wood, Quaternary stratigraphy, Till - physical properties

Taylor, R.S.

1960 Some Pleistocene Lakes of Northern Alberta and Adjacent Areas (Revised). Journal of Alberta Society of Petroleum Geologists 8:167-178.

The extent of Pleistocene lakes in northern Alberta and adjacent areas is only partly shown on the 1958 Glacial Map of Canada. A large body of literature reporting on field work of the past 75 years describes the deposits of lakes that covered much of the basins of the Peace and Athabasca rivers. A striking example is Miette Lake, over 80 miles long, which lay across the continental divide in the headquarters of the Fraser and Athabasca rivers. Lakes of considerable size also existed in the western part of the basins of the North Saskatchewan and Churchill rivers, and in the Hay River basin. These basins were all complexly interconnected by spillways or accordant surfaces. Two large lakes (Peace and Tyrrell) covered more than 45 per cent of the northern half of Alberta's surface at various times.

Location: AEU, SCI, TN 860. A32
AEPAA and ADTMP, Periodicals collection
Areas: Map areas - 74 NW, 74 SW, 83, 84, British Columbia - Northeastern, Saskatchewan - Northern
Borden areas - FP, FQ, HO, HP, HQ, IO, IP, IQ, regions as above
Topics: Glacial lake sequences

h. Northeastern British Columbia

Mathews, W.H.

1978 Quaternary Stratigraphy and Geomorphology of the Charlie Lake (94 A) Map-area, British Columbia. Geological Survey of Canada Paper 76-20. (25 pp.)

The Charlie Lake map-area lies at the western edge of the Great Plains and extends to within 10 miles of the Rocky Mountain Foothills. It is underlain by gently dipping Cretaceous sandstones and shales which contribute to a subdued topography including northwesterly trending belts of hilly and lowland terrain.

The Laurentide Ice Sheet reached the Charlie Lake area on at least three separate occasions during the Quaternary. Ice from the mountains to the west also reached the area, with the last major mountain glaciation being essentially contemporaneous with the last Laurentide Glaciation.

Occurrences of fluviatile gravels, similar in size distribution and provenance to those of the present Peace River, are known at three different levels. The highest, about 1000 feet above the Peace River, may be of preglacial age. The second, roughly 500 feet above Peace River, belongs to an early interglaciation; and the third, 100 to 200 feet above Peace River, belongs to the last interglaciation. A radiocarbon date of 27 400 years B.P. is identified with this last unit. The two interglacial gravel units are each overlain by sands, silts, and clays attributable to aggradation and ponding of Peace River by advancing Laurentide ice which ultimately covered these sediments with till. Sands and clays overlying the younger till were deposited in ice-dammed lakes during the retreating stages of Laurentide Glaciation. Isostatic tilting of the shorelines of these lakes, which rise westerly at about 2 feet per mile, is attributed to rebound following a late retreat of the western glaciers.

Postglacial entrenchment by the Peace River has occurred to a depth of as much as 700 feet, and the bedrock floor of this trench with its cover of modern flood plain gravels lies almost 200 feet lower than any earlier post-Cretaceous erosion surface. Incision to lesser depths has been produced by tributaries of the Peace River.

Quaternary history has played an important role in controlling movement, storage and availability of groundwater, in influencing landslides along river banks, in localizing supplies of gravel, as well as in perhaps affecting early postglacial migrations by animals and man.

Location : AEU, SCI, QE 185. C2 No. 76 (20)
Areas : Map areas - 94 A, British Columbia - Northeastern
Borden areas - HR, region as above
Topics : Glacial chronology, Glacial geomorphology, Glacial lake sequences, Quaternary stratigraphy

Mathews, W.H.

1955 Late Pleistocene Divide of the Cordilleran Ice Sheet. Geological Society of America Bulletin 66:1657.

Abstract: No abstract available.
Location : AEU, SCI, QE 1. G3412
Areas : Map areas - British Columbia - Northeastern
Borden areas - region as above
Topics : Ice movement indicators

Rampton, V.N.

1987 Late Wisconsin Deglaciation and Holocene River Evolution near Fort Nelson, Northeastern British Columbia. Canadian Journal of Earth Sciences 24:188-191.

Glacial lakes were formed in the Fort Nelson area by eastward-retreating Laurentide glacier ice that dammed a number of streams. These lakes drained through spillways at progressively lower elevations as the ice retreated eastward. A terrace on the Muskawa River containing sediments dated at ca. 9000 years B.P. indicates that the river had entrenched itself between 50 and 70 m below the surrounding upland by that time. Prior to final entrenchment by the Muskawa River to its present grade, a pause in downcutting ca. 9000 years BP occurred, resulting in the formation of the terrace.

Location : AEU, SCI, QE 1. C212
AEPAA and ADTMP, Periodicals collection
Areas : Map areas - British Columbia - Northeastern
Borden areas - region as above
Topics : Geomorphology - terraces, Glacial chronology, Glacial lake sequences

Rutter, N.W.

1977 Multiple Glaciation in the Area of Williston Lake, British Columbia. Geological Survey of Canada Bulletin 273. (31 pp.)

The completion of the W.A.C. Bennett Dam in 1968 resulted in the formation of Williston Lake in parts of Peace, Finlay, and Parsnip River valleys of northeastern British Columbia. Prior to flooding, extensive, well-preserved glacial deposits revealed evidence for four glacial advances. Since flooding, many of the key sections along river banks have been lost to the record.

The oldest unconsolidated sediments are oxidized gravel and sand that underlie the oldest major till unit. These are interpreted as interglacial fluvial deposits. With the onslaught of the Early glacial advance, outwash was deposited in the major river valley systems. Early till is recognized in Finlay and Parsnip river valleys (Rocky Mountain Trench), so the advance was relatively extensive with most ice originating west of the Rocky Mountain Trench. During deglaciation glaciofluvial and glaciolacustrine sediments were laid down. The next glacial advance, Early Portage Mountain, extended from west of the Rocky Mountain Trench, across the Trench into the Rockies, and onto the plateau area to the east. During deglaciation a lake formed to the east, probably dammed by Laurentide ice; glaciofluvial and glaciolacustrine sediments again were deposited. When retreat was complete to at least the upper parts of Parsnip and Finlay River valleys, the Late Portage Mountain advance occurred. This time glaciation was less extensive, and the ice was topographically controlled. It flowed down Parsnip and Finlay River valleys, through Peace River valley, and terminated at about Portage Mountain where an end moraine was constructed. The end moraine consists of deltaic gravel and sand and was formed in a lake that was dammed by Laurentide ice farther east. During deglaciation glaciolacustrine and glaciofluvial sediments were deposited in the valley systems to beyond the boundaries of the study area. In the Portage Mountain area lake level variations are indicated by eroded surfaces and beaches. Some time after deglaciation, Deserters Canyon advance occurred. This was a minor event whose till is observed with certainty only northwest of the mapped area.

Radiocarbon dates indicate that the Early and Late Portage Mountain advances and the Deserters Canyon advance are of late Wisconsin age. Early advance till and underlying interglacial deposits are likely early Wisconsin or older.

The area is underlain by material suitable for a wide variety of construction activities. Hazards, such as slumping and erosion, are critical only along the newly formed shoreline of Williston Lake. These will diminish in magnitude once the shoreline has stabilized and a permanent groundwater table is established.

Location : AEU, SCI, QE 185. A43, No. 273
AEPAA, 557.1, C16B 273
Areas : Map areas - British Columbia - Northeastern
Borden areas - region as above
Topics: Analysis of radiocarbon dates, Glacial chronology, Glacial lake sequences, Quaternary stratigraphy, Till - fabric, Till - lithology, Till - physical properties

Rutter, N.W.

1976 Multiple Glaciation in the Canadian Rocky Mountains with Special Emphasis on Northeastern British Columbia. In Quaternary Stratigraphy of North America, edited by W.C. Mahaney, pp. 409-440. Dowden, Hutchinson and Ross, Stroudsburg, Pennsylvania.

The completion of the W.A.C. Bennett Dam in 1968 has resulted in the formation of Williston Lake in parts of the Peace, Finlay, and Parsnip River valleys of northeastern British Columbia. Prior to flooding, extensive well-preserved glacial deposits revealed evidence for four glacial advances. Since flooding, many of the key sections along the banks of the rivers have been lost to the record.

The oldest unconsolidated sediments are oxidized gravel and sand that underlie the oldest major till unit. These are interpreted as interglacial fluvial deposits. With the onslaught of the Early advance, outwash was deposited in the major river valley systems. Early till is recognized in the Finlay and Parsnip river valley systems (Rocky Mountain Trench), so the advance was relatively extensive, with most ice originating west of the Rocky Mountain Trench. During deglaciation, glaciofluvial and glaciolacustrine sediments were laid down. The next advance, Early Portage Mountain, extended from west of the Rocky Mountain Trench, across the Trench into the Rockies, and out into the plateau area to the east. During deglaciation, a lake formed to the east, probably dammed by Laurentide ice. Glaciofluvial and glaciolacustrine sediments were again deposited. When retreat was complete to at least the upper parts of the Parsnip and Finlay River valleys, the Late Portage Mountain advance occurred. This time the glaciation was less extensive and the ice was topographically controlled. It flowed down the Parsnip and Finlay River valleys and out through the Peace River valley, terminating at about Portage Mountain where an end moraine was constructed. The end moraine consists of deltaic gravel and sand, and was formed in a lake that, once again, was dammed by Laurentide ice farther east. During deglaciation, glaciolacustrine and glaciofluvial sediments were deposited in the valley systems to beyond the boundaries of the investigated area. In the Portage Mountain area, varying lake levels are indicated by eroded surfaces and beaches. Sometime after deglaciation, Deserter's Canyon advance occurred. This was a minor event, whose till is observed with certainty only northwest of the mapped area.

Radiocarbon dates indicate that the Early and Late Portage Mountain advances and the Deserter's Canyon Advance are of Late Wisconsin Age. The Early advance and the underlying interglacial deposits are most likely Early Wisconsin or older.

Tentative correlations between glacial advances or equivalent till units in the Canadian Rocky Mountains and western plains are presented.

Location : AEU, SCI, QE 696. Q25 1976
AEPAA, 551.79097 M277
Areas : Map areas - British Columbia - Northeastern
Borden areas - region as above
Topics : Analysis of radiocarbon dates, Glacial chronology, Glacial lake sequences, Quaternary stratigraphy, Till - fabric, Till - lithology, Till - physical properties

Valentine, K.W.G., K.R. Fladmark, and B.E. Spurling
1980 The Description, Chronology and Correlation of Buried Soils and Cultural Layers in a Terrace Section, Peace River Valley, British Columbia. Canadian Journal of Soil Science 60:185-197.

A terrace section in the Peace River Valley of British Columbia contained seven buried paleosols developed in eolian material. Chemical, physical and micromorphological data showed the soils to be Chernozemic. The main soil-forming processes have been the leaching and reprecipitation of carbonates, the formation of mull aggregates, the weathering of primary minerals and the weak physical translocation of soil fabric. Five cultural components or levels have been identified in nearby archaeological excavations and these were correlated with the Ah horizons of five of the palaeosols. However, none of these Ah horizons contained large amounts or organic P as have been found in cultural layers of other archaeological sections. The cultural components contained tools, flakes, shell beads, bones and projectile points. Radiocarbon dates from charcoal ranged from 5830±80 yr B.P. in the second lowest paleosol to 1520±70 yr B.P. in the second highest paleosol. They showed that most of the eolian material had been deposited on the terrace by about 4500 yr B.P.; that is, by the end of the Hypsithermal. The chronology of soil development and eolian deposition are discussed by applying a previously published system of horizon designations that combines and describes the gradational and pedomorphic features in soils.

Location : AEU, SCI, S 590. C21
Areas : Map areas - 94 A, British Columbia - Northeastern
Borden areas - HR, region as above
Topics : Archaeological sites - HaPk-1, Artifacts, Geoarchaeology, Palaeosols, Soil - chemical properties, Soil - physical properties

i. Northern United States

Alden, W.C.

1953 Physiography and Glacial Geology of Western Montana and Adjacent Areas. United States Geological Survey Professional Paper 231. (200 pp.)

Western Montana, as described in this paper, constitutes all that part of the State between the Rocky Mountain front on the east and the Montana-Idaho line on the west. ...

During the Wisconsin and earlier stages of glaciation there was probably an extensive ice cap covering most, possibly all of the Yellowstone Park plateau and the Absaroka Range and Beartooth Mountains to the north and northeast, from which glacial tongues extended down the several gorges. Farther north, northwest, and west, between the Park, the Idaho-Montana State line, and the Canadian boundary, there were many local glaciers, some of them large, heading in the cirques that scallop the upper slopes of the highest mountain ranges both east and west of the Continental Divide. Some of the glaciers, especially those in and south of Glacier National Park, were so large that they extended for miles out onto the adjacent piedmont benchlands.

Abstract : Abbreviated from Author's Abstract
Location : AEU, SCI, QE 75. P96 V. 231 1953
Areas : Map areas - Montana - Glacier National Park, Montana - Western, Wyoming - Northern
Borden areas - regions as above
Topics : Glacial geomorphology, Quaternary stratigraphy

Carrara, P.E.

1987 Holocene and Latest Pleistocene Glacial Chronology, Glacier National Park, Montana. Canadian Journal of Earth Sciences 24:387-395.

Moraines of two different age groups have been identified fronting the present-day glaciers and snowfields in Glacier National Park, Montana. The subdued, vegetated moraines of the older group have been found at 25 sites, mainly in the central part of the Lewis Range. These older moraines are in places overlain by the Mazama ash. Although the exact age of the moraines has not been determined by radiocarbon dating, vegetative evidence and correlation with other pre-altithermal age moraines in the Rocky Mountains suggest that these older moraines date from 10 000 BP or earlier. Whether these moraines are the product of a separate advance after the end of the Wisconsin glaciation or are simply the product of the last advance or stillstand of Wisconsin glaciers before final deglaciation is not known.

Moraines of the younger group, consisting of fresh bouldery rubble, are common throughout Glacier Park. Tree-ring analyses indicate that some of these younger moraines were deposited by advances that culminated during the mid-19th century. At that time there were more than 150 glaciers in Glacier Park. This episode of mid-19th century climatic cooling resulted in the most extensive glacial advance in this region since the end of the Wisconsin glaciation.

Present-day glaciers have shrunk drastically from their mid-19th century positions; more than half the glaciers present during that time no longer exist. Much of this retreat occurred between 1920 and the mid-1940's, corresponding to a period of above-average summer temperatures and below-average annual precipitation in this region. Between 1966 and 1979, several of the larger glaciers in the Mount Jackson area of Glacier Park advanced as much as 100 m.

Location : AEU, SCI, QE 1. C212
AEPAA and ADTMP, Periodicals collection
Areas : Map areas - Montana - Glacier National Park
Borden areas - regions as above
Topics : Dendrochronology, Glacial chronology, Neoglaciation, Quaternary stratigraphy, Tephra - Mazama

Carrara, P.E., S.K. Short and R.E. Wilcox
1986 Deglaciation of the Mountainous Region of Northwestern Montana, U.S.A., as Indicated by Late Pleistocene Ashes. Arctic and Alpine Research 18:317-325.

During the late Wisconsin glaciation, the mountainous regions of northwestern Montana were covered by glacial ice. Marias Pass, on the Continental Divide immediately south of Glacier National Park, was covered by a local ice field. This ice and that from other glaciers to the north and south flowed eastward onto the plains of Montana to form the Two Medicine Glacier, a large piedmont glacier that extended 55 km beyond the mountain front. The presence of the Glacier Peak G ash and the underlying St. Helens Jy ash in laminated lake sediments near Marias Pass indicates that in this region the Continental Divide was ice free before about 11,400 BP. Macrofossils, pollen, and spores in these same sediments indicate establishment of shrubs, herbs, and scattered conifers by that time. At Sun River Canyon, about 90 km south of Marias Pass, glaciers also flowed beyond the mountain front onto the plains to form the Sun River Glacier, another large piedmont glacier that extended beyond the mountain front for 25 km. The presence of the Glacier Peak G ash in a postglacial alluvial fan indicates that glacial ice had receded upvalley from the canyon mouth and that the Sun River Glacier no longer existed by 11,200 BP.

Location : AEU, SCI, G 1. A68
Areas : Map areas - Montana - Northern
Borden areas - regions as above
Topics : Glacial chronology, Insect studies, Plant macrofossils - wood, pollen analysis, Tephra - Glacier Peak, Tephra - St.Helens

Fullerton, D.S., and R.B. Colton
1986 Stratigraphy and Correlation of the Glacial Deposits on the Montana Plains. In Quaternary Glaciations in the Northern Hemisphere, edited by V. Sibrava, D.Q. Bowen and G.M. Richmond, pp. 69-82. Report of the International Geological Correlation Programme Project 24, Quaternary Science Reviews, Volume 5. Pergamon Press, Oxford.

Till units representing at least three pre-Illinoian continental glaciations, at least one Illinoian glaciation, and a late Wisconsin glaciation have been identified on the Montana Plains. Early Wisconsin or middle Wisconsin till units have not been identified. The southernmost limit of late Wisconsin glaciation is in Montana, more than 170 km south of the Lethbridge moraine in Alberta, Canada (Figs 1 and 2). An interpretation that the Lethbridge moraine is the limit of late Wisconsin glaciation (Stalker, 1977, 1980, 1983b; Stalker and Harrison, 1977; Rutter 1980, 1981; Jackson, 1983) is incompatible with stratigraphic and morphologic evidence from Montana.

Location : AEU, SCI, QE 696. Q245 V5 1986

AEPAA, Periodicals collection
Areas : Map areas - 72 E, 82 H, Montana - Northern, Saskatchewan - Southern
Borden areas - DO, DP, regions as above
Topics : Glacial chronology, Review of Quaternary stratigraphy

Horberg, L.
1956 A Deep Profile of Weathering on Pre-Wisconsin Drift in Glacier Park, Montana. Journal of Geology 64:201-218.

A deep profile of weathering on pre-Wisconsin (? Kansan) Kennedy drift in Glacier Park, Montana, includes a complex B-horizon 19 feet thick, a leached horizon 57 feet thick, and $CaC0_3$-indurated horizon 93 feet thick. Samples from the weathered zone were studied in the laboratory for variations in mechanical composition and lithology. The combined silt-clay fractions were analyzed spectrographically for major and minor chemical constituents. The variations shown by the laboratory studies are correlated with horizons in the profile.

The profile is interpreted in the light of the geomorphic, glacial, and Pleistocene climate history of the region. It is concluded that the profile developed largely during the Yarmouth interglacial stage and that a complex horizon in the upper 10 feet probably developed during the Sangamon interglacial, the Tazewell-Cary interstadial of the Wisconsin, and Recent time.

Location : AEU, SCI, QE 1. J8 V64 1956
Areas : Map areas - Montana - Glacier National Park
Borden areas - region as above
Topics : Palaeosols, Soil - chemical properties, Soil - lithology, Soil - physical properties

Lemke, R.W., M.R. Mudge, R.E. Wilcox, and H.A. Powers
1975 Geologic Setting of the Glacier Peak and Mazama Ash-Bed Markers in West-Central Montana. United States Geological Survey Bulletin 1395-H. (31 pp.)

The Glacier Peak and Mazama ash beds are informally named stratigraphic markers that assist in interpreting the age and environment of deposits of late Pleistocene and Holocene age in west-central Montana. There are only three known exposures in the area that contain both ash beds. The one bed is distinguished from the other petrographically by the habit and range of refractive index of its glass shards and the refractive indices of the hornblende phenocrysts, and chemically by the composition of the glass. In the field, identification is aided by the younger Mazama ash bed generally occurring higher in the exposure, commonly within a few feet of the top, and generally being somewhat thicker and more extensive than the Glacier Peak ash bed.

The Glacier Peak ash, dated radiometrically at approximately 12,500 years B.P. (before present), occurs as light-gray to tan-gray lentils and pods, mostly in beds of silt that commonly overlie deposits of the middle stade of Pinedale Glaciation and underlie deposits of the Altithermal interval. In one exposure the ash bed is interlayered in glacial lake beds of Pinedale age. Exposures of this ash bed are not as common as those of the Mazama ash bed, and have not been found as far east.

The Mazama ash, radiometrically dated at about 6,600 years B.P., occurs near the base of the deposits of the Altithermal interval as distinct but discontinuous light-gray to tan beds that range in thickness from 0.1 foot (3 centimetres) to as much as 2.5 feet (76 centimetres). It commonly overlies a distinct fossil soil and locally is overlain by a less distinct fossil soil.

Location : AEU, SCI, QE 175. B93 No. 1395-H
Areas : Map areas - Montana - Northern
Borden areas - region as above
Topics : Glacial chronology, Glacial lake sequences, Palaeosols, Quaternary stratigraphy, Tephra - composition, Tephra - Glacier Peak, Tephra - Mazama

Mehringer, Jr., P.J., J.C. Sheppard, and F.F. Foit, Jr.
1984 The Age of Glacier Peak Tephra in West-Central Montana. Quaternary Research 21:36-41.

At Sheep Mountain Bog, near Missoula, Montana, a late-glacial tephra, that probably fell in late summer, is preserved as an 8-mm-thick graded bed overlain by another 8 mm of redeposited ash mixed with lake deposits. Sediment surrounding the ash was ^{14}C dated to about 11,200 yr B.P. Electron-microprobe analyses of the volcanic glass and hornblende phenocrysts from this ash layer indicate that they are similar in major-element chemistry to those of Glacier Peak layer G previously considered to be about 12,000 yr old or older.

Location : AEU, SCI, QE 696. Q24 V. 21 1984
Areas : Map areas - Montana - Western
Borden areas - region as above
Topics : Analysis of radiocarbon dates, Pollen analysis, Tephra - composition, Tephra - Glacier Peak

Richmond, G.M.
1986 Stratigraphy and Correlation of Glacial Deposits of the Rocky Mountains, the Colorado Plateau and the Ranges of the Great Basin. In Quaternary Glaciations in the Northern Hemisphere, edited by V. Sibrava, D.Q. Bowen and G.M. Richmond, pp. 99-127. Report of the International Geological Correlation Programme Project 24, Quaternary Science Reviews, Volume 5. Pergamon Press, Oxford.

This report summarizes the evidence for correlation of the Quaternary glacial deposits in 26 broadly distributed mountain ranges selected on the basis of availability of detailed information and length of glacial record. ... The glacial deposits in each range are treated individually to emphasize, from range to range, differences in the character of the deposits, the number of glaciations or glacial advances recognized, and the criteria for correlation utilized by different investigators.

Abstract : Part of Author's Introduction
Location : AEU, SCI, QE 696. Q245 V5 1986
AEPAA, Periodicals collection
Areas : Map areas - Montana - Glacier National Park, United States - Northern Rockies
Borden areas - regions as above
Topics : Glacial chronology, Review of Quaternary stratigraphy

Richmond, G.M.

1957 Three Pre-Wisconsin Glacial Stages in the Rocky Mountain Region. Geological Society of America Bulletin 68:239-262.

Till, believed to be of pre-Wisconsin age, is widely distributed throughout the Rocky Mountains, in most places as small isolated patches. Some deposits lack morainal form and lie only on interstream divides; others, having a poorly preserved morainal form, overlap from the canyons onto the divides.

The deposits tend to be finer-grained, more compact, and more strongly jointed than younger Wisconsin deposits. Commonly they have a thick very strongly developed mature soil profile preserved on them.

In some places, the physical relations of the deposits to one intracanyon erosion surface and two precanyon erosion surfaces suggest that they represent three stages of glaciation. This suggestion is confirmed by stratigraphic evidence in the La Sal Mountains, Utah, and in Glacier National Park, Montana, where three tills, each capped by a thick and very strongly developed mature soil profile, are superposed.

The three stages may represent the Nebraskan, Kansan, and Illinoian stages of the Mississippi Valley, but no convincing evidence for such a correlation has been found.

Location: AEU, SCI, QE 1. G341
Areas: Map areas - United States - Northern Rockies
Borden areas - region as above
Topics: Glacial chronology, Palaeosols

PART 2. LATE QUATERNARY PALAEOENVIRONMENTS

a. General

Fladmark, K.R.
1983 Times and Places: Environmental Correlates of Mid-to-Late Wisconsinan Human Population Expansion in North America. In *Early Man in the New World*, edited by R. Shutler, Jr., pp. 13-41. Sage Publications, Beverly Hills.

Abstract : No abstract available
Location : AEU, SCI, HSS, E 61. E12
Areas : Map areas - Beringia, Canada - Western, North America - Northern
Borden areas - regions as above
Topics : Archaeology - human population movement, Ice-free corridor, Review of archaeological evidence, Review of glacial history

Hills, L.V., and E.V. Sangster
1980 A Review of Paleobotanical Studies Dealing with the Last 20,000 Years: Alaska, Canada, and Greenland. In *Climate Change in Canada*, edited by C.R. Harington, pp. 73-224. National Museums of Canada, National Museum of Natural Sciences Project on Climatic Change in Canada During the Past 20,000 Years. Syllogeus No. 26. National Museum of Natural Sciences, National Museums of Canada, Ottawa.

Abstract : No abstract available
Location : AEU, SCI, QH 1. S985
Areas : Map areas - All Alberta, All Canada, Alaska, Greenland
Borden areas - All Alberta, regions as above
Topics : Publications list, Review of palaeoenvironmental studies

MacDonald, G.M., and L.C. Cwynar
1985 A Fossil Pollen Reconstruction of the Late Quaternary History of Lodgepole Pine (*Pinus contorta* ssp. *latifolia*) in the Western Interior of Canada. *Canadian Journal of Forest Research* 15:1039-1044.

Previous reconstructions of Late Quaternary biogeographical history of lodgepole pine (*Pinus contorta* Dougl.) have been based upon inferences from the modern geographical distribution of morphological and genetic variation. These studies have led to the widely accepted conclusion that relict populations of the Rocky Mountain subspecies of lodgepole pine (ssp. *latifolia* Engelm.) persisted in glacial refugia located in northwestern Canada. New fossil pollen evidence of Late Pleistocene and Holocene distribution of lodgepole pine in the western interior of Canada contradicts this view. *Pinus contorta* ssp. *latifolia* migrated northward into Canada from refugia located south of the continental glacial limits and did not reach its northern range limits in the southern Yukon until the late Holocene.

Location : AEU, SCI, SD 145. C23
Areas : Map areas - 82 J, 83 C, 83 M, 84 D, British Columbia - Northern, British Columbia - Southeastern, Northwest Territories - Southwestern, Yukon

Borden areas - EP, FQ, GQ, HQ, regions as above
Topics: Plant migration, Pollen analysis, Vegetation history - Pinus contorta

MacDonald, G.M., and J.C. Ritchie
1986 Modern Pollen Spectra from the Western Interior of Canada and the Interpretation of Late Quaternary Vegetation Development. New Phytologist 103:245-268.

The pollen spectra obtained from 127 lake sediment surface samples from the western interior of Canada are examined. Principal components biplots and discriminant analysis are used to investigate the correspondence between modern pollen rain and major vegetation zones in the study area. It is demonstrated that the major vegetation zones in the western interior of Canada can be distinguished on the basis of their modern pollen rain. Principal components biplots and discriminant analysis are also used to compare late Quaternary fossil pollen assemblages from lake located near the southern and northern periphery of the modern boreal forest with the modern pollen spectra. The results suggest that the late Pleistocene and early Holocene pollen spectra from the southern and northern periphery of the boreal forest lack modern analogues in the western interior of Canada. The northern and southern boundaries of the boreal forest were located north of their modern positions during the mid Holocene. Vegetation developed and responded to mid Holocene climatic change at different rates at the two sites. Modern vegetation conditions were established at both sites between 5000 B.P. to 3000 B.P. Vegetation has remained relatively stable during the last three thousand years.

Location: AEU, SCI, QK 1. N53
Areas: Map areas - All Alberta, British Columbia - Northeastern, Northwest Territories - Southwestern
Borden areas - All Alberta, regions as above
Topics: Modern pollen studies, Pollen analysis, Pollen analysis - multivariate statistical methods, Vegetation history - boreal forest

Packer, J.G.
1980 Paleoecology of the Ice-free Corridor, the Phytogeographical Evidence. Canadian Journal of Anthropology 1:33-35.

Abstract: No abstract available
Location: AEU, PMC, GN 1. C22
AEPAA, Periodicals collection
Areas: Map areas - 82 G, 82 H, 82 N, 82 NE, 83 B, 83 NW, 83 SW
Borden areas - DP, EP, EQ, FP, FQ, GQ
Topics: Ice-free corridor, Phytogeography, Plant refugia

Ritchie, J.C.
1987 Postglacial Vegetation of Canada. Cambridge University Press, Cambridge, England. (178 pp.)

Abstract: No abstract available
Location: AEPAA, 561.1971 R511

Areas : Map areas - All Alberta, All Canada
Borden areas - All Alberta, regions as above
Topics : Review of pollen studies, Review of vegetation history

Ritchie, J.C.
1985 Quaternary Pollen Records from the Western Interior and the Arctic of Canada. In Pollen Records of Late-Quaternary North American Sediments, edited by V.M. Bryant, Jr. and R.G. Holloway, pp. 327-352. American Association of Stratigraphic Palynologists Foundation, Austin, Texas.

This paper represents an overview of the palynological records from the Canadian Arctic Archipelago, the continental Northwest Territories, the Yukon Territory, the eastern segment of the Province of British Columbia, and all of the Provinces of Alberta, Saskatchewan, and Manitoba. Pollen data from 218 sites have thus far been published for this area and they are mentioned in this article as to their name, location, palynologist who worked at the site, time span covered by the examined sediments, and supporting paleoecological data, if present. This summary article discusses a wide variety of sites ranging from a few early and middle-Pleistocene sites to a large number of Holocene records; thus the treatment of each site has, by necessity, been condensed. A final section mentioning some of the needs for future research in this region also is included.

Location : AEA, HSS/ASA, 561.13 P763
Areas : Map areas - All Alberta, British Columbia, Manitoba, Northwest Territories, Saskatchewan, Yukon
Borden areas - All Alberta, regions as above
Topics : Review of pollen studies, Review of vegetation history

Ritchie, J.C.
1980 Towards a Late Quaternary Palaeoecology of the Ice-free Corridor. Canadian Journal of Anthropology 1:15-28.

The palaeoecology of the area known as the ice-free corridor is as poorly understood and documented as the geological evidence that there was in fact such an area. In the northern, Beringian portion the full-glacial (maximum 18,000 BP) was characterized by impoverished, tundra communities reflecting an environment colder, drier and less productive than during the Holocene and present-day. Most sites of greater apparent age (Middle Wisconsin), while they have yielded large numbers of vertebrate fossils, either lack stratigraphic context entirely or have stratigraphy of uncertain age and provenance. There is fragmentary evidence for Middle Wisconsin interstadial episodes that supported productive boreal woodland ecosystems.

Location : AEU, PMC, GN 1. C22
AEPAA, Periodicals collection
Areas : Map areas - All Alberta, Alaska - Eastern, Manitoba, Saskatchewan, Northwest Territories
Borden areas - All Alberta, regions as above
Topics : Ice-free corridor, Review of pollen studies

Ritchie, J.C.

1976 The Late Quaternary Vegetational History of the Western Interior of Canada. Canadian Journal of Botany 54:1793-1818.

The late-Wisconsinan pollen stratigraphy of the Western Interior of Canada is assembled and 16 representative sites provide a basis for establishing trends of vegetation history. Sites in the southern, prairie region show an early Picea-Artemisia assemblage (12 x 10^3 to 10 x 10^3) replaced by a zone dominated by herb pollen. Similarly, sites in the Aspen Parkland and Transitional zones all have the Picea-Artemisia zone from as early as 13.9 x 10^3 to 10 x 10^3 followed by a herb zone. It is replaced by an arboreal pollen zone as early as 4.5 X 10^3 to 3 x 10^3 B.P. While there is a broad trend common to all sites in the modern boreal forest, from an early spruce-dominated assemblage to a late postglacial spruce-pine-birch assemblage identical with modern spectra, there are differences in the details of stratigraphy. Two sites in central Alberta have a poplar zone preceding the early spruce zone. Sites near the modern southern forest boundary show a late development (3 x 10^3 B.P.) of the mixed boreal forest from prairie and hardwood deciduous forest communities. One site, at Flin Flon, Saskatchewan, provides clear evidence for a treeless episode (Artemisia-grass-sedge) preceding the spruce zone.

As the late-Wisconsinan glacial ended, an early version of the boreal forest, dominated by spruce and lacking pine, spread from adjacent U.S. on to deglaciated surfaces and till over stagnant ice. It persisted in the southern part of the area until about 10 x 10^3 and until 6 x 10^3 in the northernmost portions. In the south the spruce forest was replaced directly by prairie, spreading from the southwest and extending farther north than its modern limit between 7.5 x 10^3 and 6 x 10^3. All remnants of ice sheets and glacial lakes had disappeared by about 7 x 10^3 and the northern part of the area was occupied by a boreal forest undergoing rapid changes in composition from the early spruce-dominated version to the mixed spruce-pine-birch-poplar mosaic prevalent today. Pine probably spread from western refugia, at least into areas north and west of L. Winnipeg. At about 3 x 10^3 the southern limit of the forest extended to the south, apparently in response to a climate with cooler and (or) wetter growing seasons. The rapid replacement of the spruce-dominated boreal forest by grasslands in the early postglacial was probably a response to warmer and drier growing seasons.

Location : AEU, SCI, QK 1. C21
Areas : Map areas - 73 L, 83 I, Manitoba, Minnesota, Nebraska, South Dakota, Saskatchewan
Borden areas - GO, GP, regions as above
Topics : Review of pollen studies, Review of vegetation history

Ritchie, J.C., and G.A. Yarranton

1978 Patterns of Change in the Late-Quaternary Vegetation of the Western Interior of Canada. Canadian Journal of Botany 56:2177-2183.

Principal components analysis (PCA) of pollen data from 14 sites reveals five types of sequence. All begin from an early spruce-dominated assemblage, now apparently extinct, with subsequent differentiation into patterns of forested and grassland vegetation. A comparison of the PCA ordinations of these subfossil zones with those of modern pollen samples illustrates the uniqueness of the early spruce zone and the similarities between the subsequent zones and modern spectra. The technique demonstrates the time transgressive nature of the early spruce forest assemblage in this region.

Location : AEU, SCI, QK 1. C21
Areas : Map areas - 73 L, 83 I, Manitoba, Saskatchewan
Borden areas - GO, GP, regions as above
Topics : Pollen analysis, Pollen analysis - multivariate statistical methods, Vegetation history

Terasmae, J.
1973 Notes on Late Wisconsin and Early Holocene History of Vegetation in Canada. Arctic and Alpine Research 5:201-222.

Nearly all of Canada was covered by the Wisconsin glaciation and most of the country was deglaciated during the time from about 12,000 to 7,000 years ago. The biota generally survived the glaciation south of the ice sheets in North America in addition to survival in probable refugia along the coasts and in Yukon and the Arctic Islands.

The ice sheets (Laurentide and Cordilleran) completely disturbed the vegetation in Canada. As deglaciation occurred in response to a significant change in climate at the end of the Pleistocene (about 10,000 years ago), recolonization of Canada by vegetation proceeded from the refugia and a northward migration of biota from the southern peripheral region of glaciation. The late glacial episode differed from any subsequent Holocene time episode in terms of the availability of large areas of "raw" soils, the very large volume of meltwater runoff, and the presence of numerous large glacial lakes that at least locally affected the climate.

The main sources of information about late Wisconsin and Holocene vegetation are records of plant macrofossils and fossil pollen and spore assemblages preserved in lake sediments, peat bogs, and alluvial deposits. Genetic mixing occurred during recolonization when the populations from different refugia met after having been isolated for several thousand years.

The studies of the fossil record are seriously hindered by the lack of basic palynological data (pollen deposition and dispersal in relation to the modern vegetation) and the ecology, phytogeography, and genetics of Canadian vegetation and flora, as well as the relationships between vegetation and climate in particular.

It has been demonstrated clearly that the palynological and paleobotanical studies can provide the necessary information required for construction of paleoclimatological models that can be beneficially used in the study of environmental changes.

Location : AEU, SCI, G 1. A68
Areas : Map areas - All Alberta, All Canada
Borden areas - All Alberta, region as above
Topics : Review of vegetation history

Vance, R.E.
1987 Meteorological Records of Historic Droughts as Climatic Analogues for the Mid-Holocene in Alberta. In Man and the Mid-Holocene Climatic Optimum, edited by N.A. McKinnon and G.S.L. Stuart, pp. 17-32. Proceedings of the Seventeenth Annual Conference of the Archaeological Association of the University of Calgary, Nov. 10-12, 1984.

The purpose of this paper is to develop a model of atmospheric circulation to account for the occurrence of drought during the Holocene in western North America utilizing for the occurrence of drought during the Holocene in western North America utilizing analogues of historic drought periods. I propose to do this by first outlining atmospheric circulation patterns that have accompanied historic droughts. Secondly, varying boundary conditions in the Holocene will be described and their impact on atmospheric circulation assessed. Finally, climatic conditions associated with the hypothesized circulation model will be outlined and evaluated in the light of regional palaeoecological studies. ...

Abstract : Part of Author's Introduction
Location : IC
Areas : Map area - All Alberta
Borden areas - All Alberta
Topics : Climatic modelling

Vance, R.E.
1986 Aspects of the Postglacial Climate of Alberta: Calibration of the Pollen Record. Géographie physique et Quaternaire 40:153-160.

This reconstruction of the postglacial climate of Alberta is based on a review of pollen studies within the province and the application of calibration equations to a pollen record from central Alberta. Regional palynological studies indicate that the late glacial vegetation, dominated by non-arboreal taxa and, on occasion, Populus, was replaced by a Picea dominated assemblage between 12,000 and 10,000 BP. In central Alberta, increased herbaceous pollen representation suggests that grassland was established north of its current position in early to middle Holocene time. By 3500 BP, the grassland boundary had retreated southward. Little vegetational change is evident during the last 3500 years. Calibration equations, derived from modern pollen and climatic data in the western interior of Canada and applied to an 11,400 year pollen record, suggest growing season temperature was 1.5°C greater than at present while growing season precipitation was 50 mm below current values during the middle Holocene.

Location : AEU, PMC, G 1. R452
Areas : Map area - All Alberta, Manitoba, Northwest Territories, Saskatchewan, Yukon - Northern
Borden areas - All Alberta, regions as above
Topics : Pollen analysis - multivariate statistical methods

b. Southern Western Corridor

Christiansen, O.A., and L.V. Hills

1985 Part 1: Palynologic and Paleoclimatic Interpretation of Holocene Sediments, Waterton Lakes National Park, Alberta. In Climatic Change in Canada 5 Critical Periods in the Quaternary Climatic History of Northern North America, edited by C.R. Harington, pp. 345-354. National Museums of Canada, National Museum of Natural Sciences Project on Climatic Change in Canada During the Past 20,000 years. Syllogeus No. 55. National Museum of Natural Sciences, National Museums of Canada, Ottawa.

A sequence of palynological events spanning the last 7000 years is developed for the Waterton Lakes area. The period from 7000 to 5000 yr B.P. was warmer and drier than present, from 5000 to ?4000 yr B.P. a cooler, moister climate prevailed, followed by a warmer and drier climate from ?4000 to 3000 yr B.P., which in turn was followed by a progressive cooling of the climate from 3000 yr B.P. to the present.

Abstract : Author's Summary
Location : AEU, SCI, QH 1. S985
AEPAA, 551.6971 C613
ADTMP, QH 1. S9 No. 55
Areas : Map area - 82 G, 82 H
Borden areas - DP
Topics : Climate history, Pollen analysis, Tephra - Mazama

Dormaar, J.F.

1983 Aliphatic Carboxylic Acids in Buried Ah Horizons in Alberta, Canada as Paleoenvironmental Indicators. Canadian Journal of Earth Sciences 20:859-866.

In southern Alberta, a buried Ah horizon is frequently present beneath Mazama tephra (ca. 6600 years BP). Drainage conditions during the formation of such buried Ah horizons may determine the quality of the aliphatic carboxylic acids in the soil organic matter. The spectrum of aliphatic acids extracted from a number of buried Ah horizons indeed suggests either well drained or poorly drained conditions during soil formation regardless of the mode of deposition of materials before or after the soil-forming interval. The climate required for development of the well drained paleosols was inferred to be similar to the climate under which surficial Black Chernozemic Ah horizons were formed.

Location : AEU, SCI, QE 1. C212
AEPAA and ADTMP, Periodicals collection
Areas : Map area - 82 G, 82 H, 82 I, 82 J, 82 O, 82 P, 83 A
Borden areas - DP, EP, FP
Topics : Palaeosols, Soil - chemical properties, Soil - pedogenesis, Tephra - Mazama

Driver, J.C.

1987 Hypsithermal Paleoecology and Archaeology of the Canadian Rockies. In Man and the Mid-Holocene Climatic Optimum, edited by N.A. McKinnon and G.S.L. Stuart, pp. 345-360. Proceedings of the Seventeenth Annual Conference of the Archaeological Association of the University of Calgary, Nov. 10-12, 1984.

A constant theme of many studies of the Hypsithermal period in the northwestern Plains and adjacent areas is the refugium concept. A number of archaeologists have suggested that certain areas within the Plains, such as river valleys of prominent hills, as well as mountains to the west and forests to the north and east may have absorbed populations driven off the Plains by climatic extremes ... In this paper I examine the Canadian Rockies and consider [whether there is evidence for the Hypsithermal, whether there is archaeological evidence for human occupation, what adaptive strategy was practiced by groups using the mountains, and whether the mountains can be regarded as a "refuge".]

Data ... indicate that there was a human presence in the Rockies in the Hypsithermal. Pollen data show the most intensive changes in vegetation before and after the deposition of Mazama tephra, and a number of archaeological components also lie just below or just above the same stratigraphic marker. Such data that exist on subsistence do not show any major differences from the similarly meagre subsistence evidence of the Early Prehistoric period nor are there major changes in subsistence following the termination of the Hypsithermal. ...

Human occupation of the Rockies was continuous from Early to Late Prehistoric times, and there is no indication for a hiatus in the Hypsithermal. Furthermore, the way of life apparently resembled what went before and what came after. In this sense the Rockies can be considered as a "refugium" where there was continuity in spite of climatic change. ...

Abstract : Adapted from several sections of Author's text
Location : IC
Areas : Map area - 82 G, 82 H, 82 J, 82 O
Borden areas - DP, EP
Topics : Archaeological sites - DjPo-47, Archaeology, Artifacts, Faunal remains - Bison, Pollen analysis, Tephra - Mazama

Driver, J.C., L.V. Hills, and B.O.K. Reeves

1985 Part 3: Palynology of Crowsnest Lake, Alberta, with Comments on Holocene Paleoenvironments of the Southern Alberta Rockies and Surrounding Areas. In Climatic Change in Canada 5 Critical Periods in the Quaternary Climatic History of Northern North America, edited by C.R. Harington, pp. 370-396. National Museums of Canada, National Museum of Natural Sciences Project on Climatic Change in Canada During the Past 20,000 Years. Syllogeus No. 55. National Museum of Natural Sciences, National Museums of Canada, Ottawa.

In the preceding sections we show that the sequence of environmental events postulated for Crowsnest Pass can be equated with similar developments in other areas of Alberta and northwest North America. A generalized postglacial climate consists of an early warming trend, culminating in the Altithermal, with warmer temperatures and lower rainfall than today. Following this, two cold periods are readily documented, but the situation after 2000 yr B.P. is less certain.

Major changes affecting the prehistoric inhabitants of the Crowsnest Pass were probably few. After 10,500 yr B.P., grasslands were almost certainly established in Crowsnest Pass, and must have provided good grazing for ungulates. Forest zones gained elevation, perhaps reaching modern limits at about 9000 yr B.P. A brief decline in elevation may have occurred from 8500 to 8000 yr B.P., but the extent of the grasslands cannot have been seriously affected. Expansion of the grassland zone started shortly after this, and, by 7500 or 7000 yr B.P., the area had increased considerably. Then, subalpine forest moved up the valley sides, and increased herds occupied the grasslands and montane forest. Between 6000 and 5000 yr B.P., a change took place. Temperatures dropped, precipitation increased, and less productive subalpine forest expanded into the valley grasslands, reducing montane forest to a thin strip. At that time, vegetation zones may still have been somewhat higher in elevation than today. Following a second grassland expansion, cool, wet conditions reappeared, possibly reducing grasslands to an area approximately the same as today. With minor fluctuations in climate, this situation continued until today.

We emphasize that changes in the Crowsnest Pass have been largely quantitative. Undoubtedly the main factor in assessing the effects of environment on prehistoric man is the extent of the grasslands, because these provided habitat for the ungulates which were the subsistence base. Grasslands have not disappeared from the Crowsnest Pass at any time in the Holocene. Thus, there has always been a potential for a population of ungulates in the area - a potential probably unrivalled by any other valley in Alberta within the mountain front.

Abstract : Authors' Summary
Location : AEU, SCI, QH 1. S985
AEPAA, 551.6971 C613
ADTMP, QH 1. S9 No. 55
Areas : Map area - 82 G
Borden areas - DP
Topics : Pollen analysis, Holocene timberline fluctuations, Tephra - Mazama, Vegetation history

Fergusson, A., and L.V. Hills
1985 Part 2: A Palynological Record, Upper Elk Valley, British Columbia. In Climatic Change in Canada 5 Critical Periods in the Quaternary Climatic History of Northern North America, edited by C.R. Harington, pp. 355-369. National Museums of Canada, National Museum of Natural Sciences Project on Climatic Change in Canada During the Past 20,000 Years. Syllogeus No. 55. National Museum of Natural Sciences, National Museums of Canada, Ottawa.

Sediments from a bog in the upper Elk Valley, British Columbia have yielded a pollen profile extending back at least 13,500 years. The profile is subdivided into five pollen zones. Zone 1 (coldest) is interpreted to represent a Betula - Artemisia sagebrush shrub tundra with Salix, Alnus, Shepherdia, chenopods, minor heath and Equisetum. Zone II, dominated by Picea and Abies with Pinus increasing in the upper levels, represents replacement of the tundra by coniferous forest. Zone III, characterized by high Pinus, is interpreted to represent movement of this conifer into the area. A decrease in the pine to spruce plus fir ratios in Subzone 3a is inferred to indicate establishment of climax spruce-fir forest. Zone IV is interpreted to indicate subclimax forest due to fire. Increases in Douglas fir points to continued upslope movement of the vegetation. Zone V (youngest), characterized by an overall decrease in the pine to spruce plus fir ratios and a decrease in Douglas fir, is interpreted to indicate a cooler/moister climate than that of the preceding zone.

Abstract : Authors' Summary
Location : AEU, SCI, QH 1. S985
AEPAA, 551.6971 C613
ADTMP, QH 1. S9 No. 55
Areas : Map area - 82 J, British Columbia - Elk Valley
Borden areas - EP, region as above
Topics : Insect studies, Molluscs, Ostracods, Plant macrofossils - Bryophytes, Plant macrofossils - leaves, Plant macrofossils - wood, Pollen analysis, Tephra - Mazama, Vegetation history

Hansen, H.P.
1948 Postglacial Forests of the Glacier National Park Region. Ecology 29:146-152.

Pollen analyses of two sphagnum bog sections in Glacier National Park reveal an interesting and significant sequence of postglacial forest succession. The climate as interpreted from the recorded forest succession is fairly consistent with that interpreted from many profiles in the Pacific Northwest. The early postglacial arborescent invaders were lodgepole, white, and whitebark pines, with some subalpine fir, denoting a moist, cool climate with unstable physiographic conditions and a sterile mineral soil. The abrupt expansion of western yellow pine at and near the volcanic ash stratum strongly suggests warming and drying of the climate culminating in a xerothermic maximum which is substantiated by pollen profiles from many postglacial sedimentary columns in the Pacific Northwest. The warm-dry maximum has been dated between 8000 and 4000 years ago and it is chronologically correlated in many organic sections by the volcanic ash layer, the source of which is probably the same as that in the columns of this study. A cooler climate with increased moisture during the past 4000 years is manifested by an expansion of white pine, Engelmann spruce, and fir, and a less pronounced intrusion of western hemlock above the ash horizon. Lodgepole pine's predominance in more recent time, as well as its fluctuations relative to those of other species, is indicative of periodic pyric influence which has favoured its expansion. Western larch, which composes a high proportion of the present day forests adjacent to the sites of sedimentation, and which is largely controlled by fire, is poorly represented and its successional history is omitted from the picture of postglacial forests in the region. Climatically, the forest sequence denotes an initial cool, moist period, a second period of warming and drying, a third stage of xerothermic maximum, followed by a period of cooler and moister climate which in general has persisted to the present.

Abstract : Author's Summary
Location : AEU, SCI, QH 540. E19
AEPAA, Periodicals collection
Areas : Map area - Montana - Glacier National Park
Borden areas - region as above
Topics : Pollen analysis, Tephra - presumed Glacier Peak, Vegetation history

MacDonald, G.M., R.P. Beukens, W.E. Kieser, and D.H. Vitt
1987 Comparative Radiocarbon Dating of Terrestrial Plant Macrofossils and Aquatic Moss from the "Ice-free Corridor" of Western Canada. Geology 15:837-840.

In order to assess the reliability of aquatic moss for radiocarbon dating, ^{14}C analyses were performed on a stratigraphic series of terrestrial plant macrofossils and samples of

Drepanocladus crassicostatus from a small hard-water lake (pH = 8.2) in the "ice-free corridor" of Alberta. All ^{14}C dating was done using accelerator mass spectrometry. Mazama Ash provided an independent chronological control. The aquatic bryophyte samples consistently produced ^{14}C ages significantly older than the terrestrial macrofossils. The relation between the radiocarbon dates from the macrofossils and the moss was not linear, and age differences ranged from approximately 1400 to 6400 yr. The ^{14}C content of D. crassicostatus growing in the lake at present was less than 85% modern. Despite the apparent inability to take up ^{14}C-deficient carbon by the direct incorporation of bicarbonate, the bryophytes clearly do not provide reliable material for ^{14}C dating. The ^{14}C deficiency of aquatic mosses may be explained by the generation of ^{14}C-deficient CO_2 through isotopic exchange, the formation of CO_2 from bicarbonate by chemical processes, and metabolic CO_2 production. These results demonstrate the potential unreliability of ^{14}C dates from aquatic mosses and raise serious concerns about the deglaciation dates from the ice-free corridor that were obtained from aquatic Drepanocladus.

Location : AEU, SCI, QE 1. G3455
Areas : Map area - 82 J
Borden areas - EP
Topics : Analysis of radiocarbon dates, Ice-free corridor, Plant macrofossils - Bryophytes, Plant macrofossils - Picea remains, Plant macrofossils - wood, Tephra - Mazama

Mott, R.J., and L.E. Jackson, Jr.
1982 An 18,000 Year Palynological Record from the Southern Alberta Segment of the Classical Wisconsinan "Ice Free Corridor". Canadian Journal of Earth Sciences 19:504-513.

Radiocarbon dates of 18 300±380 years BP (GSC-2668) and 18400±1090 years BP (GSC-2670) on moss fragments from the clay near the base of a core from Chalmers Bog, Alberta indicate that the classical Wisconsinan "Ice-free Corridor" was in existence in the foothills of southern Alberta by this time. Palynological studies show sparse, herbaceous, tundra-like vegetation probably prevailed at this time in the area surrounding the small lake formed in the abandoned glacial spillway. Later, shrubs became more prominent to form a shrub tundra environment. Sometime before 8220 years BP (GSC-2851) trees began to invade the area and the Pinus contorta dominated coniferous forest extant in the area today began to form. Bog and fen vegetation invaded the shallow lake basin about this time as well to form the bog that occupies the basin to the present day.

Location : AEU, SCI, QE 1. C212
AEPAA and ADTMP, Periodicals collection
Areas : Map area - 82 J
Borden areas - EP
Topics : Ice-free corridor, Pollen analysis, Tephra - Mazama, Vegetation history

Reeves, B.O.K.

1969 The Southern Alberta Paleo-Cultural - Paleoenvironmental Sequence. In Post-Pleistocene Man and His Environment on the Northern Plains, edited by R.G. Forbis, L.B. Davis, O.A. Christiansen and G. Fedirchuk, pp. 6-46. University of Calgary Archaeological Association, Calgary, Alberta.

Abstract : No abstract available.
Location : AEU, HSS, E 78. G73 P15
Areas : Map areas - 72 E, 72 L, 82 G, 82 H, 82 NE, 83 A
Borden areas - DO, DP, EO, EP, FO, FP
Topics : Review of archaeological evidence, Review of palaeoenvironmental studies, Tephra - Mazama

Reeves, B.O.K., and J.F. Dormaar

1972 A Partial Holocene Pedological and Archaeological Record from the Southern Alberta Rocky Mountains. Arctic and Alpine Research 4:325-336.

Salvage excavations at an archaeological site (DlPo-20) located in the Front Range of the Rocky Mountains in southwestern Alberta revealed the presence of a series of living floors, radiocarbon dated at ca. 4000, 4700 and 6000 B.C., in association with the Ah horizons of a series of buried soil profiles. While archaeological information is minimal, analysis of the buried soils indicates that they formed under a different vegetation cover from that on the site today. The earliest soil, a Degraded Alpine Eutric Brunisol, inferred to have developed under subalpine to alpine vegetation and a cold wet climate, suggests depression of timberline on the order of 600 m. These climatic characteristics are considered to reflect those of the last valley glaciation (Pinedale IV). The two later buried soils, Orthic Regosols, developed under grassland vegetation reflective of a drier warmer climate, indicating the lower tree line shifted upwards a minimum of 30 m. A return to "normal" climatic conditions is correlated with the onset of the Neoglacial dated ca. 2800 B.C. in the Southern Alberta Rockies.

Location : AEU, SCI, G 1. A68
Areas : Map area - 82 G
Borden areas - DP
Topics : Archaeological sites - DlPo-20, Artifacts, Faunal remains - Bison, Palaeosols, Soil - chemical properties, Soil - pedogenesis, Soil - physical properties, Tephra - Mazama

c. Central Western Corridor

Beaudoin, A.B.

1986 Using Picea/Pinus Ratios from the Wilcox Pass Core, Jasper National Park, Alberta, to Investigate Holocene Timberline Fluctuations. Géographie physique et Quaternaire 40:145-152.

Holocene timberline fluctuations are investigated using Picea/Pinus ratios from the tephra and radiocarbon-dated Wilcox Pass Core (52°14'N, 117°13'W). Timberline elevations are calibrated by comparing Picea/Pinus ratios from the core with modern ratios obtained in surface samples of a transect from alpine vegetation in Wilcox Pass into subalpine forest in adjacent Sunwapta Pass. Ratios higher than present ratios from the site imply higher-than-present timberline elevation. The Picea/Pinus ratios imply higher-than-present timberline between ca. 6540-1480 yr BP, with a minimum about 4210 yr BP, while timberline was lower than present between ca. 1480-540 yr BP and increased in elevation after 540 yr BP. This record substantially agrees with other palaeoenvironmental records from the region. The main limitation on the technique is that it can only be applied since similar-to-present vegetation became established in the area. Hence, Picea/Pinus ratios from the Wilcox Pass core prior to ca. 6540 yr BP cannot readily be interpreted by this method.

Location : AEU, PMC, G 1. R452
Areas : Map area - 83 C
Borden areas - FQ
Topics : Pollen analysis, Holocene timberline fluctuations, Vegetation history

Clifford, H.F., and G. Bergstrom

1976 The Blind Aquatic Isopod Salmasellus from a Cave Spring of the Rocky Mountains' Eastern Slopes, with Comments on a Wisconsin Refugium. Canadian Journal of Zoology 54:2028-2032.

The blind hypogean asellid Salmasellus staganothrix Bowman (Crustacea:Isopoda) is reported from a cave spring located on the eastern slopes of the Rocky Mountains of Alberta, Canada. This is the only known aquatic isopod from Alberta and represents an extraordinary range extension for North American hypogean isopods. Water temperatures of the spring are almost constant, near 7°C, for about 9 months of the year, but fluctuate because of snow melt in May, June, and July. Dissolved oxygen is often less than 1 mg/l during the winter, and the isopod has not been collected from December through May, even though the spring is sampled at about monthly intervals. The distribution record is considered to be evidence supporting the existence of unglaciated low-elevation refugia on the eastern side of the Canadian Rocky Mountains during Wisconsin time.

Location : AEU, SCI, QL 1. C21
Areas : Map area - 83 C, 83 F
Borden areas - FQ
Topics : Biogeography - Salmasellus, Refugia

Hansen, H.P.

1949 Postglacial Forests in West Central Alberta, Canada. Bulletin of the Torrey Botanical Club 76:278-289.

Pollen analysis of four peat sections from bogs lying between Edmonton and the Rockies in west central Alberta, reveal that lodgepole pine and spruce have been the predominant forest tree species in adjacent areas during the time represented by the sedimentary columns. Since these bogs lie west of the border of the Altamount (Late Wisconsin) moraine and on older Keewatin drift, but probably east of the Late Wisconsin Cordilleran ice border, it is possible that they record pre-Late Wisconsin forests, that had persisted in an ice-free corridor during this glacial stage. This is consistent with Hultén's theory that continental western American radiants from a Beringia center had migrated southward before the Wisconsin glaciations and persisted ice-free areas close to or within the ice front during at least the Late Wisconsin stage. The postglacial warm, dry interval, evidenced from so many sources, may be slightly recorded by an influx of grasses with some chenopods and composites in the vicinity of the Edson bog, 125 miles west of Edmonton.

Abstract : Author's Summary
Location : AEU, SCI, QK 1. T69
Areas : Map area - 83 F, 83 G
Borden areas - FP, FQ
Topics : Pollen analysis, Tephra - unknown source, Vegetation history

Harris, S.A., and B. Ciccone

1986 Reply to Comments on "Palaeoecology and Palaeogeography Near Cochrane, Alberta, Canada, Just After the Last Major High Stand of Glacial Lake Calgary". Palaeogeography, Palaeoclimatology, Palaeoecology 55:87-94.

Abstract : No abstract available
Location : AEU, SCI, QE 500. P15 V55-56 1986
Areas : Map area - 82 O
Borden areas - EP
Topics : Analysis of radiocarbon dates, Glacial chronology, Glacial sequences

Harris, S.A., and B. Ciccone

1983 Palaeoecology and Palaeogeography Near Cochrane, Alberta, Canada, Just After the Last Major High Stand of Glacial Lake Calgary. Palaeogeography, Palaeoclimatology, Palaeoecology 41:175-192.

This paper describes a fossiliferous section through a mound of Lake Calgary sediments at 1201 m elevation at Grid Reference 6671, 6701 south of Cochrane, Alberta, Canada. The section lies just west of the zone of interaction of Cordilleran and Laurentide ice sheets. These lake deposits can be traced laterally to sections where they overlie gravels of the "Bighill Creek Formation" dated previously at about 11,300 - 10,200 radiocarbon years B.P. The lake maximum is therefore younger. The sediments indicate that forest occurred around the glacial lake until shortly after 9650 yr B.P. and that contemporary forest fires produced charcoal. As air temperatures rose, grassland replaced the forest, and the ice melted. The lake had drained by 8145 yr B.P.

Location : AEU, SCI, QE 500. P15
Areas : Map area - 82 O
Borden areas - EP
Topics : Glacial lake sequences, Ostracods, Plant macrofossils - Chara oogonia, Pollen analysis, Sediments - physical properties

Harris, S.A., and E. Pip
1973 Molluscs as Indicators of Late- and Post-Glacial Climatic History in Alberta. Canadian Journal of Zoology 51:209-215.

Molluscs dated from 13 000 radiocarbon years B.P. to the present day were sampled at sites throughout southwestern Alberta. The ratio of southern forms (those presently occurring only south of 55°N) to northward-ranging species (those also occurring north of 55°N) in the major chronological sediment zones reflected the main climatic trends of the period. A study of present-day ecological preferences of the species allowed speculation on successional status of past terrestrial vegetation, agreeing satisfactorily with a previously published pollen diagram from central Alberta. Three major climatic periods could be identified: (1) a warming trend with precipitation higher than that of today from the beginning of the Laurentide ice retreat until about 9000 radiocarbon years B.P., (2) still warmer but drier conditions 9000 to 7000 radiocarbon years B.P., and (3) gradual cooling and drying until present-day conditions.

Location : AEU, SCI, QL 1. C21
Areas : Map area - 82 G, 82 H, 82 J, 82 O, 83 B
Borden areas - DP, EP, FP
Topics : Molluscs, Tephra - Mazama

Heusser, C.J.
1956 Postglacial Environments in the Canadian Rocky Mountains. Ecological Monographs 26:253-302.

1. Glacier variations and pollen profiles provide evidence for reconstructing the postglacial environments in the Canadian Rocky Mountains. The area of investigation is constituted by Robson, Jasper, Banff, and Yoho Parks which are situated along more than 250 mi. of the continental divide in the provinces of Alberta and British Columbia. ...
3. Data were gathered from 12 glaciers between the vicinity of Mt. Robson to the northwest and that of Kicking Horse Pass at the southeast, a distance of 175 miles. ... Research methods involved sectioning of trees tilted by ice-thrust during maximum stands, and also, the coring of trees of the ancient regional forest as well as those established on moraines and outwash.
4. Peat sections were removed from 4 deposits by means of a Hiller borer fitted with additional shafts. Sites are at Moose Lake, near Jasper, near Sunwapta Falls, and along Moraine Lake Road. The Jasper section was the longest at 4.0 m in length and consisted of sedge peat overlying limnic sediments in which a stratum of volcanic ash was present at 3.0 m depth. The pollen sequence shows pine-spruce-fir constituting the early record and succeeded by pine-spruce-Douglas fir, thence pine-spruce-fir, and finally pine-spruce-western hemlock.
5. The environments implied by the pollen and glacier data are represented by intervals of cool and moist climate during the early and late postglacial with the thermal maximum

interposed. The last postglacial is coincident with glacier rejuvenation at which time a series of maxima was attained in the seventeenth, eighteenth, and nineteenth centuries. The latter is thought to have been the most dynamic since in several instances it exceeded, at least in part, positions reached by earlier advances. After about 1930, recession, which has been conspicuously progressive from the second half of the nineteenth century, has been more pronounced. This trend is in keeping with the meteorological record which shows warming and a decrease in precipitation from the late 1800's up until the late 1930's. Since the early 1940's temperatures have fallen and precipitation has risen into the present decade. A lag in the response of glaciers to this most recent climatic change seems apparent as all termini visited in 1953 were retreating. Elsewhere in North America certain glaciers appear to be undergoing regeneration, particularly those in the Pacific Northwest.

Abstract : Abbreviated from Author's Summary
Location : AEU, SCI, QH 540. E28
AEPAA, Periodicals collection
Areas : Map area - 82 N, 82 O, 83 C, 83 D, 83 E, British Columbia - Mount Robson Provincial Park, British Columbia - Yoho National Park
Borden areas - EP, EQ, FQ, regions as above
Topics : Pollen analysis, Tephra - presumed Glacier Peak, Vegetation history

Jackson, Jr., L.E.
1986 Comments on "Palaeoecology and Palaeogeography Near Cochrane, Alberta, Canada, Just After the Last Major High Stand Glacial Lake Calgary". Palaeogeography, Palaeoclimatology, Palaeoecology 55:79-87.

Abstract : No abstract available
Location : AEU, SCI, QE 500. P15 V55-56 1986
Areas : Map area - 82 O
Borden areas - EP
Topics : Analysis of radiocarbon dates, Glacial chronology, Glacial lake sequences

Kearney, M.S., and B.H. Luckman
1987 A Mid-Holocene Vegetational and Climatic Record from the Subalpine Zone of the Maligne Valley, Jasper National Park, Alberta (Canada). Palaeogeography, Palaeoclimatology, Palaeoecology 59:227-242.

Pollen, macrofossils and isotopic data (^{13}C, ^{18}O) from gastropod shells are used to reconstruct Holocene vegetational and climatic changes for a lower subalpine forest site (elevation 1690 m) in the Maligne Valley, Jasper National Park, Alberta. Subalpine forest has characterized the site since the inception of the sedimentary record in this small pond ca. 8500 yr B.P. In contrast to the vertical timberline fluctuations recorded at nearby sites above present tree-line, vegetational changes at the site appear to have been mainly horizontal, i.e. forest cover and tree density expanded or contracted laterally in response to climatic warming or cooling. At Maligne Lake forest cover was probably at its maximum extent about 7500 yr B.P., when Pseudotsuga and other montane elements had migrated to this elevation but did not displace the existing vegetation. The modern mosaic of discontinuous subalpine forest and extensive dwarf birch-dominated damp meadows and fens emerged only during the last 1300 years.

A warmer Neoglacial episode, dated ca. 2600-3400 yr B.P., is indicated by increases in the temperature-limited gastropod, Lymnaea palustris, and by progressive enrichment in the ^{18}O and ^{13}C contents of their shells. Summer temperatures during this period, which has been tentatively identified elsewhere in the Canadian Rockies, may have risen by as much as 1.8°C.

Location : AEU, SCI, QE 500. P15
Areas : Map area - 83 C
Borden areas - FQ
Topics : Carbon isotope studies, Holocene timberline fluctuations, Molluscs, Plant macrofossils - needles, Plant macrofossils - seeds, Plant macrofossils - wood, Pollen analysis, Oxygen isotope studies

Kearney, M.S., and B.H. Luckman
1983 Postglacial Vegetational History of Tonquin Pass, British Columbia. Canadian Journal of Earth Sciences 20:776-786.

A pollen and macrofossil study of peat sediments in Tonquin Pass, British Columbia provides the oldest dated record of vegetational and climatic changes in the middle Canadian Rockies. Paleoecological interpretation of these events dated by tephrochronology and radiocarbon dating is facilitated by comparisons with other regional pollen profiles.

Late Wisconsin ice receded from Tonquin Pass prior to 10 000 years BP. By 9700 years BP a Pinus contorta forest with an understory dominated by ferns had colonized the area. The climate of this period was cool and moist. Following this interval was a brief episode (9000 - 8040 years BP) of haploxylon pine dominance during which the climate became colder. A long warm period beginning by 8040 years BP was characterized by desiccation of local meadows and fens and invasions of these areas by trees, principally Picea. Dated fossil Picea and Abies logs from alpine bogs within Jasper National Park document that timberline had advanced beyond present limits by 8770 years BP. These data indicate a considerable lag in the registration of this interval in the Tonquin record.

During the last 4300 years the retreat of trees from meadows and increases in the representation of several alpine taxa indicate that generally moist and cool conditions have prevailed. Evidence for Holocene timberline fluctuations in the Jasper area suggests an overall lowering in timberline elevation and further cooling since 1700 years BP.

Location : AEU, SCI, QE 1. C212
AEPAA and ADTMP, Periodicals collection
Areas : Map area - 83 D
Borden areas - FQ
Topics : Holocene timberline fluctuations, Plant macrofossils - needles, Plant macrofossils - wood, Pollen analysis, Tephra - Bridge River, Tephra - Mazama, Tephra - St. Helens, vegetation history

Kearney, M.S., and B.H. Luckman
1983 Holocene Timberline Fluctuations in Jasper National Park, Alberta. Science 221:261-263.

Pollen, fossil logs, and macrofossils from three high-elevation sites in the Maligne Range, Jasper National Park, Alberta, provide the first detailed record of timberline fluctuations in the Canadian Rockies during the last 8700 years. Timberlines were much higher than present between 8700 to 5200 years ago but oscillated significantly in elevation, with a major episode of timberline recession punctuating two periods of high timberline between about 6700 to 5900 and about 8700 to 7000 years ago. Since 5200 years ago, regional timberlines have generally receded with perhaps brief reversals, reaching their lowest recorded positions sometime after 500 years ago.

Location : AEU, SCI, Q 1. S41
AEPAA, Periodicals collection
Areas : Map area - 83 C, 83 D
Borden areas - FQ
Topics : Holocene timberline fluctuations, Plant macrofossils - needles, Plant macrofossils - wood, Pollen analysis, Tephra - Mazama, Vegetation history

Kearney, M.S., and B.H. Luckman
1981 Evidence for Late Wisconsin-Early Holocene Climatic/ Vegetational Change in Jasper National Park, Alberta. In Quaternary Paleoclimates, edited by W.C. Mahaney, pp. 85-105. GeoAbstracts, Norwich, England.

Basal C^{14} dates of 9660 and 9600 yr. BP from two sites close to the Continental Divide indicate late-Wisconsin glaciers had receded to positions at or close to their present limits prior to 10,000 yr. BP. The deposits of two subsequent glacial advances have been recognised by Luckman and Osborn (1979). The older advances (Crowfoot) is represented by moraines and rock glacier deposits which predate 6600 yr. BP. The younger advance (Cavell) was usually the most extensive Holocene glacial event and shows very limited rock glacier development. Intermediate-age advances may occur on some rock glaciers, but no absolute dating control is available for these features.

Preliminary pollen diagrams are presented for the early Holocene period (c. 9700-500 yr BP) for 3 sites in different ecological environments: Excelsior Basin (2150 m, above treeline), Tonquin Creek (1935 m, subalpine) and Maligne Lake (1675 m, montane forest). Three major vegetation/climatic zones are recognised but the two oldest are present only in the Tonquin diagram and have no contemporary analogues in pollen rain data from the area. The earliest zone (9700-9200 yr. BP) dominated by the pollen of Pinus contorta and Polypodiaceae may be largely seral in nature or indicate slightly warmer conditions than present. The succeeding Pinus albicaulis-Abies lasiocarpa-Picea engelmannii zone (9200-8500 yr. BP) suggests slightly cooler conditions. The Hypsithermal Interval (8500-5500 yr BP) is present at all three sites and has two warmer phases separated by a cooler period between 800-7500 yr BP. Palynological and macrofossil evidence indicates that during the warmer periods valley floor sites dried out and treeline advanced at upper elevations. Dated tree remains from sites above present treelines confirm the occurrence of higher treelines than at present c. 98-, 5920 and 8060 yr. BP. The available pollen data suggest that the Crowfoot Advance occurred between 9200-8500 yr. BP or predates 9700 yr. BP.

Location : AEU, SCI, QC 884. Q25 1981
Areas : Map area - 83 C, 83 D
Borden areas - FQ
Topics : Glacial chronology, Plant macrofossils - needles, Plant macrofossils - wood, Pollen analysis, Tephra - Mazama, vegetation history

Lichti-Federovich, S.
1970 The Pollen Stratigraphy of a Dated Section of Late Pleistocene Lake Sediment from Central Alberta. *Canadian Journal of Earth Sciences* 7:938-945.

A 5.5 m section of limnic sediment from Lofty Lake in the Mixedwood Section of the Boreal Forest in central Alberta has yielded the first complete Late Pleistocene pollen stratigraphy for the province. The basal organic sediment was radiocarbon dated at 11 400 ± 190 y (GSC-1049) and a layer of Mount Mazama type ash was recognized at the 398 cm level. This represents the furthest extension into Canada of Mazama ash records. Five pollen assemblage zones have been identified - at the base, a *Populus-Salix-Shepherdia-Artemisia* assemblage, which is unique in the Late Pleistocene of N. America, and is interpreted as a pioneer forest and shrub community which occupied the area immediately following deglaciation. This is succeeded by a spruce dominated assemblage which conforms in general to many early Late Pleistocene *Picea* assemblages from western Canada and adjacent United States, interpreted as a pioneering version of the boreal forest. There follows a tree birch-dominated assemblage with poplar and hazel, suggesting a slight amelioration of climate, and this trend appears to have continued to about 6000 B.P. when a birch - alder - herb assemblage reaches its maximum; this is followed by a spruce - birch - alder assemblage, which continued to the present and is interpreted as an expression of a deterioration in climate about 3500 B.P. The apparent absence at the site of grassland, although the birch - alder - herb assemblage suggests that the grassland might have advanced closer to the site than at present (240 km (150 miles)), supports the hypothesis that there never a Late Pleistocene connection between the Peace River and the main southern grasslands.

Location : AEU, SCI, QE 1. C212
AEPAA and ADTMP, Periodicals collection
Areas : Map area - 83 I
Borden areas - GP
Topics : Pollen analysis, Tephra - Mazama, Vegetation history - boreal forest

Luckman, B.H., and M.S. Kearney
1986 Reconstruction of Holocene Changes in Alpine Vegetation and Climate in the Maligne Range, Jasper National Park, Alberta. *Quaternary Research* 26:244-261.

Pollen, macrofossil (logs and needles), and oxygen-isotope data from tree rings are presented for three alpine bog sites in the Maligne Range of the Canadian Rockies. Organic sedimentation at the Watchtower site began prior to ca. 9500 ^{14}C yr B.P. and by 8770 yr B.P. timberlines were at least 100 m above present levels. The two pollen records are dominated by *Pinus* and subsequent changes in timberlines are inferred from pollen-ratio data (*Abies/Pinus*) and from macrofossils. The recovered records indicate two periods of high Hypsithermal timberlines ca. 8800-7500 and 7200-5200 yr B.P. separated by a short interval ca. 7300-7400 yr B.P. when timberline approached modern levels. After ca. 4500 yr B.P. timberlines have been similar to or lower than present, reaching minimum values in the last 500 yr.δ^{18}O determinations from the α-cellulose of samples of 5 or 10 annual rings cut from contemporary *Picea engelmannii* at timberline show strong correlations with mean annual temperatures at Jasper. Isotopic determinations from Hypsithermal-age logs recovered from sites above timberline indicate mean annual temperatures were at least 0.5°C warmer ca. 8060 and 8770 yr B.P than at present at the Watchtower site. Data from logs at the Maligne Pass site suggest that temperatures were about 1.2° and 1.6°C warmer ca. 6000 and 5300 yr B.P.

Estimates of temperature from the pollen-ratio data are more conservative and suggest maximum differences of ca. 1.0°C in July temperatures over the last 8000 yr.

Location : AEU, SCI, QE 696. Q24
AEPAA, Periodicals collection
Areas : Map area - 83 C, 83 D
Borden areas - FQ
Topics : Holocene timberline fluctuations, Oxygen isotope studies, Plant macrofossils - needles, Plant macrofossils - wood, Pollen analysis, Tephra - Mazama, Vegetation history

MacDonald, G.M.

1982 Late Quaternary Paleoenvironments of the Morley Flats and Kananaskis Valley of Southwestern Alberta. Canadian Journal of Earth Sciences 19:23-35.

A 3.1 m section of limnic sediment and peat from a bog on the Morley Flats and a 2.8 m section of limnic sediment from Wedge Lake in the Kananaskis Valley have yielded the first comprehensive late Quaternary biostratigraphic record from southwestern Alberta. Both sections were analyzed for subfossil pollen, molluscs, and several sedimentary indices. Two distinct pollen zones were recognised. The basal zone, characterized by relative abundancy of Artemisia-Salix-Juniperus, suggests that the Morley Flats were dominated by a sparse vegetation composed of aggressive pioneer species following deglaciation until prior to approximately 10 000 BP. Similarly, the mollusc fauna from this zone is dominated by northern ranging species. The second zone is typified by a predominance of Pinus and Picea. This reflects the expansion of coniferous forest into the region. Both the relative abundance of southern ranging mollusc species and the total carbonate concentration in the sediment increase in this zone. The vegetation of the region has remained generally stable since at least 9395 BP. However, increases in the abundance of Pinus relative to Picea and Abies in the mid-Holocene suggest that this period experienced an increase in fire frequency, possibly generated by climatic amelioration.

Location : AEU, SCI, QE 1. C212
AEPAA and ADTMP, Periodicals collection
Areas : Map area - 82 J, 82 O
Borden areas - EP
Topics : Molluscs, Pollen analysis, Sediments - chemistry, Tephra - Mazama, Vegetation history

Packer, J.G., and D.H. Vitt

1974 Mountain Park: A Plant Refugium in the Canadian Rocky Mountains. Canadian Journal of Botany 52:1393-1409.

It is suggested that the area in the vicinity of Mountain Park, Alberta, (52°50'N; 117°20'W) in the Canadian Rocky Mountains was a refugium during the Wisconsin period, where alpine and montane bryophytes and flowering plants survived the glaciation in situ. Evidence for this view includes data derived from geological investigations and from the present distribution of a number of bryophyte and angiosperm species. Alternative explanations to account for these distributions are discussed and reasons for rejecting them as highly improbable are presented.

Location : AEU, SCI, QK 1. C21
AEPAA, Periodicals collection
Areas : Map area - 83 C
Borden areas - FQ
Topics : Disjunct plant distributions, Plant refugia

Wilson, M., and A. La Rocque
1973 Fossil Gastropods From a Paleo-Indian Archaeological Site in Calgary, Alberta, Canada: Local and Regional Significance. Sterkiana No. 49:1-10. Ohio State University, Columbus, Ohio.

In November, 1968 salvage archaeological excavations were conducted at the Mona Lisa site (EgPm-3 in the Canadian site numbering system) in Calgary, Alberta, Canada. ...

Bison bones constitute nearly the entire faunal sample from the site; these have been tentatively identified as a small form of Bison bison occidentalis. ... However, a small sample of gastropods was recovered during the preparation of the bone material. ...

In summary, there is very slender evidence from gastropod distributions that temperatures may have been slightly warmer or conditions slightly drier 8000 years ago than at present, at the Mona Lisa site. However, the complexity of the problem involved restricts our speculation in this regard. There is no clear evidence for major climatic fluctuations.

Abstract : Adapted from Authors' Introduction and Synthesis
Location : ILL, ACSP
Areas : Map area - 82 O
Borden areas - EP
Topics : Archaeological sites - EgPm-3, Faunal remains - Bison, Molluscs

d. Northern Western Corridor

Hansen, H.P.

1952 Postglacial Forests in the Grande Prairie-Lesser Slave Lake Region of Alberta, Canada. Ecology 33:31-40.

Pollen profiles from eleven peat sections in the Grande Prairie-Lesser Slave Lake region of Alberta reveal that pine (Pinus) is more abundantly represented in the western part and becomes less abundant eastward with the exception of the eastern-most section which lies on the pine-forested sandy glacial outwash north of Edmonton. The pollen proportion averages of pine decrease eastward while those of spruce (Picea) conversely increase. In nine sections pine is recorded to its maximum at the top while spruce attains its maximum at some point between the top and bottom. The expansion of pine in the upper levels may reflect the influence of fire and a drier climate in more recent time. Fir (Abies) is only slightly represented and its trends do not seem to be significant. The absence of aspen (Populus) pollen, due to its poor preservation, undoubtedly distorts the pollen profiles and presents an incomplete picture of forest succession.

The chronology of the recorded forest history is not clear because it is not known whether the region was covered by the Late Wisconsin ice, although vast lakes in the region probably prevented extensive forest development until postglacial time. The relative shallowness of the muskegs does not point to great antiquity, and they may have developed since the warm, dry maximum. The region was postglacially invaded by species of the subalpine Cordilleran forest, the boreal forest and the grassland. Species of the Cordilleran and boreal forest may have persisted in refugia in northeastern British Columbia and central Yukon during the last glaciation.

Abstract : Author's Summary
Location : AEU, SCI, QH 540. E19
AEPAA, Periodicals collection
Areas : Map area - 83 M, 83 N, 83 O, 83 P
Borden areas - GP, GQ
Topics : Pollen analysis, Tephra - unknown source, Vegetation history

MacDonald, G.M.

1987 Postglacial Development of the Subalpine-Boreal Transition Forest of Western Canada. Journal of Ecology 75:303-320.

(1) The subalpine-boreal transition forest of western Canada has long been of interest because of its mixture of boreal and subalpine species. However, an understanding of vegetation dynamics in the region is impeded by a lack of information on long-term patterns of vegetation development, peatland formation and fire activity.

(2) Fossil pollen and charcoal from the sediments of small lakes in the northern subalpine-boreal transition region are used to reconstruct the postglacial history of regional vegetation change, peatland development and fire. Interpretation of the fossil pollen spectra is aided by multivariate numerical comparison with modern spectra from western Canada.

(3) From 11 000 B.P. until 5000 B.P. there was continuous vegetation change. There are no modern, regional analogues for the early postglacial communities. By approximately 5000 B.P. the extent of peatland and fire activity were similar to the modern conditions. Vegetation has remained relatively constant since then.

(4) The pattern of vegetation development in the subalpine-boreal transition forest is

completely different from postglacial vegetation development in the subalpine forest, but has clear similarities with the early Holocene development of the southern boreal forest.

Location : AEU, SCI, QK 1. C21
Areas : Map area - 84 D, British Columbia - Northeastern
Borden areas - HQ, region as above
Topics : Charcoal - fire history, Pollen analysis - multivariate statistical methods, Vegetation history

White, J.M., and R.W. Mathewes
1986 Postglacial Vegetation and Climatic Change in the Upper Peace River District, Alberta. Canadian Journal of Botany **64:2305-2318.**

Pollen analysis and radiometric dating of sediment cores from two lakes in the Saddle hills, Peace River district, Alberta, were used to investigate postglacial vegetation and climatic change. A poplar-willow-sage-grass-sedge zone began about 11 700±260 years BP. A distinct pine and spruce rise indicates the local presence of conifers. Peace River spruce could have served as a source for spruce in the Yukon, transported by glacial meltwater conceivably as early as about 11 100 years BP. A paper birch rise and spruce decline between about 8700 and 8200 years BP is likely due to fires during a period of enhanced seasonality. It is suggested that subsequent weakening of the anticyclone associated with the Laurentide ice lengthened the growing season, permitting pine to be the major fire successor to spruce. During the pine peak ca. 7400 years BP there was no grassland over the Saddle Hills, so the Peace River grasslands cannot be explained as Hypsithermal relict vegetation. Conditions similar to the present were apparently reached by about 5000 years BP.

Location : AEU, SCI, QK 1. C21
AEPAA, Periodicals collection
Areas : Map area - 83 M
Borden areas - GQ
Topics : Pollen analysis - multivariate statistical methods, Vegetation history

White, J.M., R.W. Mathewes, and W.H. Mathews
1985 Late Pleistocene Chronology and Environment of the "Ice-Free Corridor" of Northwestern Alberta. Quaternary Research **24:173-186.**

Pollen and macrofossil analyses of two radiocarbon-dated lake sediment cores in the upper Peace River district were used to investigate the controversial late-glacial geochronology of the "ice-free corridor". The basal mineral-rich sediments contain reworked, radiogenically "dead" palynomorphs, as well as intrusive "modern" carbon. Analyses of basal sediments from Boone Lake show that two ^{14}C ages greater than 12,000 yr B.P. are spuriously old due to contamination by organic matter of Cretaceous age. The data support occlusion or near occlusion of Laurentide and Cordilleran ice in the Peace River area during the late Wisconsinan period. The sediment record began around 12,000 yr B.P. in the ice-dammed and enlarged Boone Lake. An initially open, sedge-dominated cover was invaded by sage, willow, grass, and poplar by 11,700 yr B.P. suggesting that a habitable landscape has existed in the area for at least 12 millennia. The data, however, do not support the ice-free corridor arguments of Reeves, B.O.K. (1973, Arctic and Alpine Research 5, 1-16: In "Quaternary Coastlines and Marine Archaeology: Towards the Prehistory of Land

Bridges and Continental Shelves" (P.M. Masters and N.C. Flemming, Eds.), pp. 389-411. Academic Press, New York), who suggests that ice occlusion did not occur in the Peace River Valley during the last 55,000 yr.

Location : AEU, SCI, QE 696. Q24
AEPAA, Periodicals collection
Areas : Map area - 83 M, 94 A, British Columbia - Northeastern
Borden areas - HR, GQ, region as above
Topics : Analysis of radiocarbon dates, Ice-free corridor, Molluscs, Ostracods, Plant macrofossils - seeds, Pollen analysis, Vegetation history

White, J.M., R.W. Mathewes, and W.H. Mathews
1979 Radiocarbon Dates from Boone Lake and their Relation to the "Ice-free Corridor" in the Peace River District of Alberta, Canada. Canadian Journal of Earth Sciences 16:1870-1879.

Four new radiocarbon dates spanning the period of 10 740±395 to greater than 30 000 BP from a core taken from the bed of a high-level lake in the Saddle Hills of northwestern Alberta suggest that these hills escaped glacial overriding during late Wisconsinan glaciation.

Location : AEU, SCI, QE 1. C212
AEPAA and ADTMP, Periodicals collection
Areas : Map area - 83 M
Borden areas - GQ
Topics : Analysis of radiocarbon dates, Glacial lake sequences, Ice - free corridor, Molluscs

e. Central and East-Central Alberta

Emerson, D.

1983 Late Glacial Molluscs from the Cooking Lake Moraine, Alberta, Canada. Canadian Journal of Earth Sciences 20:160-162.

Several species of freshwater mollusc, with radiocarbon dates of 10 900 - 9050 years BP have been recovered from supraglacial and intraglacial lacustrine sediments in the Cooking Lake moraine region of south-central Alberta, Canada. The organisms indicate the onset of a warming trend in the region that lasted at least 2000 years, marking the final stages of melting of the continental Wisconsin ice sheet.

This period of climatic amelioration correlates with a similar trend in southwestern Alberta during the time interval 13 000 - 9000 years BP based also on the evidence of late and early postglacial molluscan communities.

Location : AEU, SCI, QE 1. C212
AEPAA and ADTMP, Periodicals collection
Areas : Map area - 83 H
Borden areas - FP
Topics : Molluscs

Hansen, H.P.

1949 Postglacial Forests in South Central Alberta, Canada. American Journal of Botany 36:54-65.

Pollen analysis of seven peat sections in the vicinity of Edmonton, Alberta, reveal that pine is predominantly represented throughout. The age of the sections is uncertain, but it seems probable that most of them are post-Altamont (Late Wisconsin), while some may be a little older. Unless pine is over-represented, its recorded predominance in the lowest level is somewhat anomalous as compared with the record of spruce-fir predominance in the earliest postglacial pollen-bearing sediments of the Great Lakes region and New England. Several possible causes of this disparity are suggested. An influx of grasses, chenopods, and composites denotes a warm, dry maximum during the Postglacial, which is further supported by the present extent of the black soil zones showing that grasslands were far more extensive at one time than at present. An abrupt increase of spruce to its maximum in the upper levels suggests a cooler and moister climate in more recent time. Continued spruce expansion to the present apparently was interrupted by fire and cultivation, the first probably more prevalent in the Cordilleran forest to the west where lodgepole pine has recently expanded. Clearing of spruce forests in the vicinity of the bogs may also be responsible for spruce decline in the upper two horizons of most sections.

Abstract : Author's Summary
Location : AEU, SCI, QK 1. A51
AEPAA, Periodicals collection
Areas : Map area - 83 A, 83 H, 83 I
Borden areas - FP, GP
Topics : Pollen analysis, Tephra - unknown source, Vegetation history

Hickman, M., and D.M. Klarer

1981 Paleolimnology of Lake Isle, Alberta, Canada (Including Sediment Chemistry, Pigments and Diatom Stratigraphy). Archiv für Hydrobiologie 91:490-508.

The paleolimnology of Lake Isle, Alberta, Canada (latitude 52°37'; longitude 114°26') was investigated using sediment chemistry, pigments and diatom stratigraphy. Calcium, carbonates and iron fluctuations indicated that during the warm, dry hypsithermal period the lake became shallower. The lake, always productive, was most productive during this time. Also, diatom stratigraphy was limited to this period because before and afterwards numbers were too small to provide valid counts; moreover, those present were fragmented and too badly eroded. Benthic species (mainly Fragilaria spp.) initially dominated but were quickly replaced by planktonic species (e.g. Stephanodiscus hantzschii, S. astraea, Cyclotella comta, Tabellaria fenestrata). The volcanic ash from Mt. Mazama disrupted the natural aging process and benthic species assumed importance immediately afterwards (epipelic species). The post-hypsithermal period is characterized by little change.

Location : AEU, SCI, QH 301. A67
Areas : Map area - 83 G
Borden areas - FP
Topics : Diatoms, Palaeolimnology, Pigments, Sediments - chemistry, Tephra - Mazama

Hickman, M., C.E. Schweger, and T. Habgood

1984 Lake Wabamun, Alta.: A Paleoenvironmental Study. Canadian Journal of Botany 62:1438-1465.

Results from paleoenvironmental investigations of Lake Wabamun, Alta. (longitudes 114°26' and 114°44' W; latitudes 50°30' and 53°35' N), show that the sedimentary record spans the Holocene period in the case of the core taken from the deepest portion of the lake (the Seba core), while the record from the shallow Moonlight Bay spans a somewhat shorter interval. Basically, the lake has changed little during the last 4000 years except for increases in submersed hydrophytes in Moonlight Bay and undoubtedly other shallow regions of the lake. Production, too, has changed little during this interval except in Moonlight Bay, where hydrophytes and benthic algae contributed more to the sedimentary organic matter and fossil pigments. The deposition of the Mt. Mazama tephra in the catchment area and lake at 6600 years BP may have had a profound effect upon the lake. Increased turbidity occurred. This together with climatic changes including increased precipitation and catchment area instability caused rapid infilling of the lake and low production. Moreover, prior to deposition of the tephra layer, water levels were lower and the water was more saline with Ruppia present, a feature found in other lakes in Alberta during the Hypsithermal period. Finally, prior to this period the lake was similar to its present day condition except during its very beginning when more turbid conditions prevailed.

Location : AEU, SCI, QK 1. C21
AEPAA, Periodicals collection
Areas : Map area - 83 G
Borden areas - FP
Topics : Diatoms, Palaeolimnology, Pollen analysis, Sediments - chemistry, Tephra - Mazama, Vegetation history, Vegetation history - Ruppia

Holloway, R.G., V.M. Bryant, Jr., S. Valastro

1981 A 16,000 Year Pollen Record from Lake Wabamun, Alberta, Canada. Palynology 5:195-208.

Analysis of fossil pollen from Lake Wabamun sediments record a Late Quaternary vegetational record for the last 16,000 years and indicates that the area between the Laurentide and Cordilleran ice centers was ice free since at least 16,000 years B.P. Pollen influx and pollen percentage data indicate a vegetational sequence beginning with a tundra vegetation from 16,000-11,750 years ago. By 11,750 years B.P., birch and alder colonized the area but was soon followed by a cold climate type coniferous forest composed primarily of spruce with some elements of birch and poplar. A warming trend begins around 9250 years B.P. which culminates in the Hypsithermal. However, pollen preservation is too poor during this portion of the record for direct vegetational reconstruction. Immediately following the Hypsithermal, a spruce-poplar vegetational association was present that was similar to some boreal forest areas in northern Alberta. Around 2000 years B.P. the pollen influx values decline and suggest a shift to a poplar-dominated vegetation with spruce still abundant. This vegetation assemblage seems to have marked the beginning of the present aspen grove and parkland vegetation found in central Alberta today.

Location : AEU, SCI, QE 993. P18
Areas : Map area - 83 G
Borden areas - FQ
Topics : Analysis of radiocarbon dates, Pollen analysis, Vegetation history, Tephra - undetermined source

Ouellet, M.

1983 Late Glacial Molluscs from the Cooking Lake Moraine, Alberta, Canada: Discussion. Canadian Journal of Earth Sciences 20:1619-1620.

Abstract : No abstract available
Location : AEU, SCI, QE 1. C212
AEPAA and ADTMP, Periodicals collection
Areas : Map area - 83 H
Borden areas - FP
Topics : Molluscs

f. Northern Alberta

Vance, R.E.

1986 Pollen Stratigraphy of Eaglenest Lake, Northeastern Alberta. Canadian Journal of Earth Sciences 23:11-20.

Pollen analysis of a 7.65 m sediment core from Eaglenest Lake (57°46'N, 112°06'W) provides evidence of the postglacial development of vegetation in the mixedwood section of the Boreal Forest. From the time of deglaciation (approximately 12 000 - 11 500 years BP) to 11 000 BP the area was colonized by mainly nonarboreal flora dominated by Artemisia and Gramineae. Populus, the only tree taxon present, grew in sheltered areas, while Salix and Cyperaceae were common on poorly drained sites. Open parkland prevailed under a dry, windy climate. Summer temperatures were rising rapidly from glacial minima in response to increased solar insolation. By 11 000 BP Picea (initially P. glauca) and Betula (mainly tree Betula) migrated to the area. Forest prevailed, but the canopy was likely more open than at present. By 9000 BP peak warm and dry conditions had passed, although conditions warmer and drier than present persisted. Alnus migrated to the area 8450 BP. Pinus reached the Birch Mountains about 7500 BP. No major changes in vegetation have occurred since that time, suggesting that modern climatic conditions were established by 7500 BP.

Location : AEU, SCI, QE 1. C212
AEPAA and ADTMP, Periodicals collection
Areas : Map area - 84 H
Borden areas - HP
Topics : Pollen analysis, Vegetation history

g. Northeastern British Columbia

White, J.M., and R.W. Mathewes

1982 Holocene Vegetation and Climatic Change in the Peace River District, Canada. Canadian Journal of Earth Sciences 19:555-570.

A sediment core from a pond on the Alberta Plateau in the Peace River district of British Columbia was studied using pollen analysis and radiocarbon dating. Percentage and influx diagrams were produced, and radiocarbon dates were corrected to calendar years to calculate the sedimentation rate. The 231 cm core terminated in clay, and a basal date of 7250±120 years BP was obtained, several thousand years after the recession of Glacial Lake Peace. The formation of the pond is interpreted as resulting from a climatic change, probably a transition from the peak of the Hypsithermal. Zone 1, from 7250 to 5500 years BP, is interpreted as representing a seasonal slough, with upland vegetation percentages consistent with a boreal forest. At about 5500 years BP a permanent pond with surrounding sedge wetlands was formed. Vegetation has been essentially modern during the last 3100 years. Measurements of spruce grains suggest the presence of black and white spruce throughout the pollen record. The formation of permanent ponds and wetlands on the Alberta Plateau at about 5500 years BP is thought to have been the most important vegetation change of the last 7000 years, which may have affected faunal and human populations.

Location : AEU, SCI, QE 1. C212
AEPAA and ADTMP, Periodicals collection
Areas : Map area - 94 A, British Columbia - Northeastern
Borden areas - HR, region as above
Topics : Pollen analysis, Vegetation history

h. Northern United States

Elias, S.A.

1988 Climatic Significance of Late Pleistocene Insect Fossils from Marias Pass, Montana. Canadian Journal of Earth Sciences **25:922-926.**

A small insect fossil assemblage was recovered from Late Pleistocene lake sediment below the Mount St. Helens Jy ash near Marias Pass, Montana. The insect fauna contains several arctic, alpine, and open-ground beetles, including Bembidion sulcipenne hyperboroides and possibly Holoboreaphilus nordenskioeldi. This fauna, in conjunction with the plant macrofossil evidence, suggests that at about 11 400 BP treeline was at least 450 m lower than present.

Location : AEU, SCI, QE 1. C212
AEPAA and ADTMP, Periodicals collection
Areas : Map area - Montana - Northern
Borden areas - region as above
Topics : Insect studies, Tephra - St. Helens, Timberline fluctuations - Late Wisconsinan

PART 3. LATE QUATERNARY PALAEONTOLOGY

a. General

Churcher, C.S.
1984 Faunal Correlations of Pleistocene Deposits in Western Canada. In Correlation of Quaternary Chronologies, edited by W.C. Mahaney, pp. 145-157. GeoBooks, Norwich, England.

The mammalian Quaternary record of the Canadian Prairies as revealed since 1960 represents a nearly continuous vertebrate record since Aftonian (Olduvai Palaeomagnetic Event) times. Sites are located chiefly in southern Saskatchewan and prairie Alberta (including the Peace River District), and contain the major mammalian taxa for that time span and type of environment. Last and first occurrences of at least 17 genera (and their species) enable Canadian mammalian palaeofaunas to be temporally located in concert with geomagnetic and radiometric data.

Location : AEU, SCI, QE 696. C82 1984
AEPAA, 551.79 Q29
Areas : Map area - All Alberta, British Columbia - Northeastern, Saskatchewan - Wellsch Valley
Borden areas - All Alberta, regions as above
Topics : Faunal remains, Review of faunal studies

Harington, C.R.
1985 Comments on Canadian Pleistocene Mammals. Acta Zoologica Fennica 170:193-197.

The most productive Pleistocene mammal localities occur around the margin of the relatively barren, formerly heavily glaciated Precambrian Shield. The most significant land mammal sites occur in the Prairies and unglaciated parts of the Yukon. In Saskatchewan, the Wellsch Valley site has yielded our best evidence of an early Pleistocene fauna. An impressive sequence of mammalian remains, extending from middle Pleistocene to the present, is exposed at Medicine Hat, Alberta. The richest known sites in Canada are the Dawson and Old Crow areas of the Yukon. Dawson localities have produced unusually well-preserved specimens of late Wisconsin age, which are generally exposed in the course of placer mining for gold. In contrast, bones exposed by the winding Old Crow River tend to be more poorly preserved, but represent a greater variety of species. Canada is bounded by three oceans, Atlantic, Pacific, and Arctic, a fact that is obvious when marine mammal remains are considered. Of particular interest in this regard are recently discovered walrus skeletons found in place near Qualicum Beach, Vancouver Island and Moncton, New Brunswick. They indicate the more southerly distribution of this species during early and Late Wisconsin time, respectively. In future, I suggest that a systematic paleontological testing of Canadian caves would be valuable. Other important Pleistocene mammal sites may be found in the western Canadian Arctic Islands, particularly Banks Island.

Location : IC, AEUB
Areas : Map area - 72 L, 82 G, 82 J, Northwest Territories, Ontario - Southwestern, Quebec - Southeastern, Saskatchewan - Wellsch Valley, Yukon

Borden areas - DP, EO, EP, regions as above
Topics: Faunal remains, Review of faunal studies

Harington, C.R.
1978 **Quaternary Vertebrate Faunas of Canada and Alaska and Their Suggested Chronological Sequence. Syllogeus No. 15. National Museums of Canada, Ottawa. (105 pp.)**

Thirty-one Canadian and Alaskan Quaternary vertebrate faunas, ranging in age from about 1,800,000 to 5,000 years, are reviewed against a background of some of the major characteristics of the ice age in northern North America, and an attempt is made to outline their chronological sequence. For each fauna a list of species is given, and the following points are dealt with where possible: suggested geological age, stratigraphy at the site, palaeoenvironmental implications, and pertinent references. Where interest seems to warrant it, single species or specimens are discussed. Radiocarbon dates on bone from Pleistocene vertebrates or from associated organic material are included.

In conclusion, significant features of the faunas are reviewed from oldest to youngest and in relation to several faunas of similar age from northeastern Siberia and the Great Plains of the United States. Early man is mentioned briefly. Evidence suggests that people were present in the northern Yukon about 27,000 years ago, and perhaps even earlier than 32,000 years ago in southern Alberta.

Location: AEU, SCI, QH 1. S985
AEPAA, 556.0971 H224
ADTMP, QH 1. S9 No. 15
Areas: Map area - All Alberta, Alaska, British Columbia, Manitoba, New Brunswick, Northwest Territories, Nova Scotia, Ontario, Quebec, Saskatchewan, Yukon
Borden areas - All Alberta, regions as above
Topics: Faunal remains, Review of faunal studies, Taber child

Sternberg, C.M.
1963 **Additional Records of Mastodons and Mammoths in Canada. Natural History Papers, Number 19. National Museum of Canada, Department of Northern Affairs and Natural Resources. (11 pp.)**

Abstract: No abstract available
Location: ADTMP, QH 1. N4 P4 No. 19
Areas: Map area - All Alberta, British Columbia, Manitoba, New Brunswick, Northwest Territories, Ontario - Southwestern, Saskatchewan - Southern
Borden areas - All Alberta, regions as above
Topics: Faunal remains - Mammuthus, Faunal remains - Mastodon

Sternberg, C.M.
1930 **New Records of Mastodons and Mammoths in Canada. The Canadian Field Naturalist 44:59-65.**

Abstract: No abstract available
Location: AEU, SCI, QM 1. C21
AEPAA, Periodicals collection
Areas: Map area - All Alberta, British Columbia - Southern, Ontario - Southwestern, Saskatchewan - Southern
Borden areas - All Alberta, regions as above
Topics: Faunal remains - *Mammuthus*, Faunal remains - *Mastodon*

b. Southern Western Corridor

Brown, R.M., H.R. Andrews, G.C. Ball, N. Burn, Y. Imahori, and J.C.D. Milton
1983 Accelerator ^{14}C Dating of the Taber Child. Canadian Journal of Archaeology 7:233-237.

The "Taber Child", a fragmentary human infant skeleton found near Taber, Alberta in 1961, has been dated by tandem accelerator measurement of the radiocarbon content of the collagenous residue obtained from 1.6 g of bone. Special care was taken to ensure removal of preservatives applied to the specimen in past years. An age of 3550±500 radiocarbon years, equivalent to 4100±750 calendar years before present, was found.

Location : AEU, PMC, FC 65. C1152
AEPAA, Periodicals collection
Areas : Map area - 82 H
Borden areas - DP
Topics : Archaeological sites - DlPa-4, Analysis of radiocarbon dates, Taber Child

Burns, J.A.
1987 Late Quaternary Zoogeography of the Northern Pocket Gopher, Thomomys talpoides, in Southwestern Alberta. Canadian Field-Naturalist 101:419-422

In Alberta, the Northern Pocket Gopher, Thomomys talpoides, is typically a species of the parklands and grasslands. However, recent evidence (1969-1984) has revealed that gophers have extended their range into the Rocky Mountains of southern Alberta in at least five locations. Mid-Wisconsin Interstadial fossils of these animals have also been identified from two caves in the Front Range. It has been suggested that the effects of grazing contribute to the spread of gophers. It is suggested here that a similar relationship may have existed in the past between bison and gophers. Expansion of gopher distribution into the mountains receives support from both late Quaternary and recent findings.

Location : AEU, SCI, QM 1. C21
Areas : Map areas - 82 G, 82 J
Borden areas - DP, EP
Topics : Faunal remains - Thomomys, Biogeography - Thomomys

Burns, J.A.
1982 Water Vole Microtus richardsoni (Mammalia, Rodentia) from the Late Pleistocene of Alberta. Canadian Journal of Earth Sciences 19:628-631.

A Late Pleistocene specimen of the water vole has been recovered from a cave in the Rocky Mountains of southwestern Alberta. Pleistocene records for this species are rare and this specimen is probably the oldest known. The evolutionary history of Microtus richardsoni, although yet uncertain, is tentatively discussed. Information is gained concerning the paleoenvironment of southwestern Alberta during late(?) mid-Wisconsinan time.

Location : AEU, SCI, QE 1. C212
AEPAA and ADTMP, Periodicals collection

Areas : Map area - 82 G
Borden areas - DP
Topics : Cave deposits, Faunal remains - Microtus

Burns, J.A.
1980 The Brown Lemming, Lemmus sibiricus (Rodentia, Arvicolidae), in the Late Pleistocene of Alberta and its Postglacial Dispersal. Canadian Journal of Zoology 58:1507-1511.

The first fossil remains of Lemmus sibiricus south of Beringia are reported from a rock shelter called January Cave in the Front Ranges of the Rocky Mountains, southwestern Alberta, Canada. The 45 specimens were excavated along with several thousands of isolated small mammal teeth and fragmentary bones. Dated by both radiocarbon and thermoluminescence methods to span the last 22 000 - 23 000 years, a late Pleistocene-through-present sequence is provided. Argument is made for the existence of a southern relict population of this lemming prior to a northward, postglacial dispersal into British Columbia and the Yukon Territory.

Location : AEU, SCI, QL 1. C21
AEPAA, 559.42 D82
Areas : Map area - 82 J
Borden areas - EP
Topics : Cave deposits, Faunal remains - Lemmus

Driver, J.C.
1982 Early Prehistoric Killing of Bighorn Sheep in the Southeastern Canadian Rockies. Plains Anthropologist 27:265-271.

The remains of three bighorn sheep were excavated from early Holocene pond deposits in the Crowsnest Pass, Alberta. The sheep show evidence of patterned disarticulation and butchery. The types of bones recovered suggest the presence of some form of communal hunting and meat sharing. Although sheep were present in the Rockies throughout the Holocene, their remains are scarce from Early Prehistoric sites in Canada. It is suggested that the sheep kill dates to 8500 B.P., based upon a radiocarbon date and a projectile point from the same pond deposits.

Location : AEU, PMC, E 51. P69
AEPAA, Periodicals collection
Areas : Map area - 82 G
Borden areas - DP
Topics : Archaeological sites - DjPo-47, Artifacts, Faunal remains - Ovis

Graham, M.A., M.C. Wilson, and R.W. Graham

1987 Palaeoenvironments and Mammalian Faunas of Montana, Southern Alberta, and Southern Saskatchewan. In Late Quaternary Biogeography and Environments of the Great Plains and Prairies, edited by R.W. Graham, H.A. Semken, Jr., and M.A. Graham, pp. 410-459. Illinois State Museum, Scientific Papers, Vol. XXII.

... During the late Pleistocene the northern plains area was predominantly an open environment with grassland species dominating. Intermixed with them in appropriate microenvironments were arctic species ... In general, these mammalian communities were probably supported by a parkland environment with a variety of microhabitats for the arctic and boreal species. ...

This type of environmental mosaic extended at least from northern Wyoming (Natural Trap and Prospects Shelter) through central Montana (False Cougar Cave) into western Alberta (January Cave). However, environmental gradients existed from north to south as well as from east to west. ...

The Pleistocene faunas of the northern plains also appear to be characterized by combinations of species that are allopatric today. ... The northern plains faunas may be somewhat different than other late Pleistocene disharmonious associations in that southern species extended north. ...

Faunal change through the late Pleistocene is poorly understood. ... The remains of Mammuthus, Camelops, and Equus from river deposits in southern Alberta and Saskatchewan indicate that part of the Pleistocene megafauna began to colonize previously glaciated landscapes before their extinction. This is interesting from a paleoecological perspective since their demise appears to have occurred fairly rapidly at the end of the Pleistocene (ca. 10,000 years B.P.). The types of environmental changes that took place during this time for the northern plains are not known.

Also, little is known about early Holocene environments in this part of the northern plains. However, some boreal species appear to have persisted at lower elevations during this time. ...

Faunas from the middle Holocene tend to reflect a warming and drying trend. ...

The late Holocene faunas are more numerous for this region of the plains than faunas from any other time period. ... However, all of these late Holocene faunas reflect modern dry grassland environments. ...

Abstract : Shortened from Authors' Conclusions
Location : IC
Areas : Map area - 72 L, 82 G, 82 H, 82 I, 82 O, 82 P, Montana, Saskatchewan - Southern
Borden areas - DP, EO, EP, region as above
Topics : Faunal remains, Review of faunal studies

Langston, W., and L. Oschinsky

1963 Notes on Taber "Early Man" Site. Anthropologica 5:147-150.

Abstract : No abstract available
Location : AEU, PMC, GN 1. A62
Areas : Map area - 82 H
Borden areas - DP
Topics : Archaeological sites - DlPa-4, Artifacts, Faunal remains, Taber child

Moffatt, E.A., and I.N.M. Wainwright

1983 Protein Concentrations in the Taber Child Skeleton: Probable Evidence for a Late Chronology. Canadian Journal of Archaeology 7:223-231.

Protein has been determined in fragments of the Taber Child by infrared spectrophotometry. A comparative study indicated that the protein content was consistent with the specimen being less than 10,000 years old. Infrared spectrophotometry has general applicability for the analysis of bone material in the screening of specimens prior to radiocarbon dating, in determining the relative age of material from a stratum, and in examining bones consolidated with synthetic resins.

Location : AEU, PMC, FC 65. C1152
AEPAA, Periodicals collection
Areas : Map area - 82 H
Borden areas - DP
Topics : Archaeological sites - DlPa-4, Taber Child

Stalker, A. MacS.

1983 A Detailed Stratigraphy of the Woodpecker Island Section and Commentary on the Taber Child Bones. Canadian Journal of Archaeology 7:209-222.

Excavations at the Woodpecker Island Site during the summer of 1979 have permitted a much more detailed description of the geology there to be made than was previously possible. The Taber Child bones came from alluvium in the lower part of a unit that records a transition from non-glacial sediments at the bottom to glacial outwash, combined with alluvium, at the top. These latter deposits were laid down close to an advancing glacier and are directly overlain by glacial deposits, including four till sheets of Classical Wisconsin Age. Stratigraphy and the condition and preservation of the bones, along with type and cementation of the sand matrix that surrounded them, all indicate that the bones are old and were laid down before advance of the last glacier. Indeed, a source for the bones higher in the section seems precluded. The small amount of bone present, its porosity and the preservatives applied to it, debar its dating by normal radiocarbon or amino acid methods.

Location : AEU, PMC, FC 65. C1152
AEPAA, Periodicals collection
Areas : Map area - 82 H
Borden areas - DP
Topics : Archaeological sites - DlPa-4, Geoarchaeology, Quaternary stratigraphy, Taber Child

Stalker, A. MacS.

1977 Indications of Wisconsin and Earlier Man from the Southwest Canadian Prairies. Annals of New York Academy of Science 288:119-136.

The Taber Child is the most direct evidence for the presence of man on the Canadian Prairies before the retreat of the last Wisconsin glacier. It consist of the skull and some other bones from a four-month-old child, found in alluvial sand some 60 feet below prairie level at a fresh exposure along the Oldman River just north of Taber, Alberta. Because the sand beds lie beneath classical Wisconsin till, the child is at least 18,000 years old. Further, the bones compare in mineralization and preservation with mid-, or perhaps classical, Wisconsin bones recovered from near Medicine Hat, to the east. Elsewhere the unit that contained them has yielded radiocarbon dates on wood of >32,000 and >49,000 years. The best estimate of their age is about 40,000.

At the Reservoir Gully Site in Medicine Hat, Alberta, intertill beds of probable midclassical Wisconsin age contain fractured cherts that do not appear to have formed naturally. Because these beds are no older than those that contained the Taber Child, and are perhaps substantially younger, the fracturing could well have been done by man. In addition, older sites near Medicine Hat, and possibly others in Saskatchewan, have yielded cherts that appear to be fractured and flaked by man. These sites are in Sangamon beds, probably between 120,000 and 80,000 years old. Both Reservoir Gully and the Sangamon sites contain abundant, scattered bones from animals well suited to support a human population.

Abstract : Author's Summary
Location : AEU, SCI, Q 11. N52
Areas : Map area - 72 L, 82 H, Saskatchewan - Southern
Borden areas - DP, EO, region as above
Topics : Archaeological sites - DlPa-4, Artifacts, Faunal remains, Taber child

Stalker, A. MacS.

1969 Geology and Age of the Early Man Site at Taber, Alberta. __American Antiquity__ **34:425-428.**

Human bones, found by the writer's geological field party in 1961, came from a cliff (Woodpecker Island Bluff) on the east side of Oldman River about 3 mi. north of Taber, Alberta. This paper discusses stratigraphy of the bluff and age of the bones, which have been described by Langston and Oschinsky (1963). The bones cannot be dated directly; however, they were found about 60 ft. below prairie level, in a sand unit lying beneath a till sheet. As the till was deposited by a Classical Wisconsin ice sheet that spread over the area more than 22,000 years ago, the bones are at least that old. Correlation with other bluffs along Oldman River indicates they are more than 32,000 years, and probably more than 37,000 years old.

Location : AEU, PMC, CC 1. A6
AEPAA, Periodicals collection
Areas : Map area - 82 H
Borden areas - DP
Topics : Archaeological sites - DlPa-4, Artifacts, Faunal remains, Taber child

Sundick, R.I.

1980 The Skeletal Remains from the Taber Child Site, Taber, Alberta. __Canadian Review of Physical Anthropology__ **2:1-6.**

An analysis of a four to nine month old human infant with a possible date of at least 40,000 years, from Taber, Alberta, is presented. The specimen was found by A. MacS. Stalker in 1961 and has been reconstructed by the present author. The skeletal material derives primarily from the left side of the skull and face and, based on the degree of mineralization of the bone and the density of the matrix in which the material was embedded, it appears likely that the specimen is as old as has been suggested. The fact that only one side of the skull and face is present would indicate that erosion of the missing right side occurred before the specimen was embedded in the matrix. Loss of the right side after mineralization would have been unlikely because of the density of the matrix.

Location : AEU, SCI, GN 49. C215
Areas : Map area - 82 H
Borden areas - DP
Topics : Taber child

Trylich, C., and L.A. Bayrock
1966 Bison occidentalis Lucas Found at Taber, Alberta, Canada. Canadian Journal of Earth Sciences 3:987-995.

An articulated incomplete skeleton of a mature male Bison occidentalis Lucas was found in alluvial sand on the uppermost terrace of the Oldman River near Taber, Alberta. Description of the bones and some comparison with ox and horse are made. Two radiocarbon ages of 10 500 and 11 000 years coupled with invertebrate fossil and pollen analyses show that at this time the area was free of ice and that parkland vegetation was well established in Southern Alberta. The pebble chopper found in association with the skeleton points to human occupation of the area at that time.

Location : AEU, SCI, QE 1. C212
AEPAA and ADTMP, Periodicals collection
ARC, Contribution Series 340
Areas : Map area - 82 H
Borden areas - DP
Topics : Artifacts, Faunal remains - Bison, Molluscs, Plant macrofossils - wood, Pollen analysis

Wilson, M.
1980 Morphological Dating of Late Quaternary Bison on the Northern Plains. Canadian Journal of Anthropology 1:81-85.

For 12,000 years plains bison have decreased in size at a fairly uniform rate. Dwarfing was under way earlier; but we have few data bearing upon rates through the Wisconsin glaciation. Cranial data from Wyoming populations, plus data from finds in nearby states and provinces, show that dwarfing continued through the Holocene (Wilson 1975:237, 1978:13). Bison even 1,000 to 2,000 years ago were larger than the modern plains form.

Abstract : Author's Introduction
Location : AEU, PMC, GN 1. C22
AEPAA, Periodicals collection
Areas : Map area - 82 NE
Borden areas - EP
Topics : Faunal remains - Bison

Wilson, M.C., D.W. Harvey, and R.G. Forbis

1983 Geoarchaeological Investigations of the Age and Context of the Stalker (Taber Child) Site, DlPa 4, Alberta. Canadian Journal of Archaeology 7:179-207.

Detailed archaeological excavations were carried out in 1978 and 1979 at the Stalker site (DlPa 4), north of Taber, Alberta. Their purpose was to clarify the stratigraphic sequence at the site, to evaluate the probable context of the human remains, and to search for additional human or faunal remains. The Quaternary deposits exposed included tills, intertill sands, ice-contact lacustrine deposits, Holocene slope deposits, and mudflow deposits. Slope retreat in recent years has not been as extensive at the site as originally believed, and Holocene deposits from an earlier gully cycle were identified. Diamictons that initially appeared to be till blocks in the orange intertill sands proved upon excavation to be Holocene mudflows, and contained bones (bison and jackrabbit). Bones of these species and pronghorn antelope were also recovered from Holocene slope deposits. Sediment samples from various units and from the Taber Child specimen were subjected to semi-quantitative X-ray diffraction spectrometry and percentage compositions of major mineral constituents were compared. The Taber Child matrix was diamictic and did not closely resemble sediment samples from the orange (rusty) intertill sands formerly thought to be the deposit of origin. Closer resemblances were noted with other deposits, including the Holocene mudflows. Given the presence of mudflow deposits within about one metre of the estimated discovery point, it is concluded that the Taber Child specimen could reasonably have come from Holocene deposits at the site. Cementation of matrix around the fossil was due to seepage at the site and is not an indicator of great antiquity.

Location : AEU, PMC, FC 65. C1152
AEPAA, Periodicals collection
Areas : Map area - 82 H
Borden areas - DP
Topics : Archaeological sites - DlPa-4, Diamicton - mineralogy, Geoarchaeology, Taber Child

c. Central Western Corridor

Churcher, C.S.
1975 Additional Evidence of Pleistocene Ungulates from the Bow River Gravels at Cochrane, Alberta. Canadian Journal of Earth Sciences 12:68-76.

Bison occidentalis (extinct western bison), Ovis canadensis (mountain sheep), and Equus conversidens (extinct Mexican ass) are represented by new specimens recovered since 1968. The bison is represented by four additional horn-cores, a third lower molar and other elements; the sheep by a manual proximal phalanx, and the horse by four lower cheek-teeth and postcranial material.

Location : AEU, SCI, QE 1. C212
AEPAA and ADTMP, Periodicals collection
Areas : Map area - 82 O
Borden areas - EP
Topics : Faunal remains - Bison, Faunal remains - Equus, Faunal remains - Ovis

Churcher, C.S.
1968 Pleistocene Ungulates from the Bow River Gravels at Cochrane, Alberta. Canadian Journal of Earth Sciences 5:1467-1488.

Five ungulates are reported from gravels comprising the second major terrace above the Bow River's north bank at Cochrane, Alberta. These ungulates are Cervus canadensis (wapiti), Rangifer tarandus (caribou), Ovis canadensis (mountain sheep), Bison occidentalis (extinct western bison), and Equus conversidens (extinct Mexican ass). E. conversidens was previously known from middle and late Pleistocene beds of the southern United States and Mexico and is here reported from the post-Wisconsin Pleistocene of Alberta and possibly Saskatchewan. Radiocarbon analysis of Bison bones from the gravels yielded two dates that averaged 11 065 B.P.

Location : AEU, SCI, QE 1. C212
AEPAA and ADTMP, Periodicals collection
Areas : Map area - 82 O
Borden areas - EP
Topics : Faunal remains - Bison, Faunal remains - Cervus, Faunal remains - Equus, Faunal remains - Ovis, Faunal remains -Rangifer

Harington, C.R., and D.M. Shackleton
1978 A Tooth of Mammuthus primigenius from Chestermere Lake near Calgary, Alberta, and the Distribution of Mammoths in Southwestern Alberta. Canadian Journal of Earth Sciences 15:1272-1283.

A well-preserved molar of a woolly mammoth (Mammuthus primigenius) was recovered from deposits at Chestermere Lake near Calgary. It is probably of late Wisconsin age, and is one of several mammoth fossils collected from Pleistocene sediments in the Calgary area.

The Chestermere Lake specimen is considered in relation to 94 records of mammoth cheek teeth from the western Canadian provinces. Of the 94 records, 5 are from Manitoba, 35 are from Saskatchewan, 37 are from Alberta, and 17 are from British Columbia. In addition to specimens of woolly mammoths, remains of Columbian (Mammuthus columbi), imperial (Mammuthus imperator), and southern mammoths (Mammuthus meridionalis) have been collected from Pleistocene deposits of southwestern Canada. Some problems concerning the relationships of North American and Eurasian mammoths are mentioned.

Location : AEU, SCI, QE 1. C212
AEPAA and ADTMP, Periodicals collection
Areas : Map area - 82 P
Borden areas - EP
Topics : Faunal remains - Mammuthus

Shackleton, D.M., and L.V. Hills
1977 Post-glacial Ungulates (Cervus and Bison) from Three Hills, Alberta. Canadian Journal of Earth Sciences 14:963-986.

Remains of wapiti and bison are reported from a Holocene (9630 ± 300 years BP, and 9670 ± 160 years BP) deposit at Three Hills, Alberta. The wapiti, although slightly larger, is assignable to the extant Cervus elaphus nelsoni. The bison is conspecific with the extinct Bison occidentalis. Detailed morphologic comparisons are made with extant and extinct species of both.

Location : AEU, SCI, QE 1. C212
AEPAA and ADTMP, Periodicals collection
Areas : Map area - 82 P
Borden areas - EP
Topics : Faunal remains - Bison, Faunal remains - Cervus

Wilson, M.
1974 Fossil Bison and Artifacts from the Mona Lisa Site, Calgary, Alberta. Part 1: Stratigraphy and Artifacts. Plains Anthropologist 19:34-45.

In November, 1968, salvage excavations at the site of an art gallery under construction in urban southwest Calgary, Alberta, Canada, revealed a Paleo-Indian bison kill. The single kill level lay at a depth of more than 250 cm. in flood plain deposits of the Bow River, now flowing more than a mile north of the site. The bone bed was overlain by a thick deposit of Mazama Ash (6600 years B.P.). A bone radiocarbon date of 8080±150 years B.P. (G.S.C.-1209) was obtained. Intermittent pedogenesis and fineness of enclosing sediments indicate an overbank flood plain situation for the kill; evidently the site area was repeatedly flooded, probably seasonally, before and after the kill episode. No evidence of a jump-off is present, although this is inconclusive at present. In the 30 square meters excavated at Locality A there was evidence for three activity loci relating to processing of carcasses. The lithic sample includes only crude butchering tools, precluding cultural assignment. Several bone tools, most of them fashioned from tibiae, appear to have been used as expedient and expendable butchering tools at the kill. Some modification of the butchering of lower limbs is noted, apparently to facilitate the production of the bone tools.

Location : AEU, PMC, E 51. P69 V. 19 1974
AEPAA, Periodicals collection
Areas : Map area - 82 O

Borden areas - EP
Topics: Archaeological sites - EgPm-3, Artifacts, Faunal remains - Bison, Tephra - Mazama

Wilson, M.C., and C.S. Churcher
1984 The Late Pleistocene Bighill Creek Formation and its Equivalents in Alberta: Correlative Potential and Vertebrate Palaeofauna. In Correlation of Quaternary Chronologies, edited by W.C. Mahaney, pp. 159-175. GeoBooks, Norwich, England.

The Late Pleistocene Bighill Creek Formation is a paraglacial gravelly fill in the Bow River valley of Alberta. It represents a warm interval following deglaciation, and is characterised by a rich large-mammal palaeofauna including Mammuthus, Equus, Camelops, Rangifer, Ovis, and Bison. On the Bow this unit is radiocarbon dated between 11 500 and 10 000 yr BP with a probable overall spread from about 12 000 to 10 000 or 9500 yr BP. Similar fossiliferous fills are present in other Alberta drainages that share an origin in mountainous terrain and thus likely share a paraglacial genesis. It is argued, however, that ice-drop gravels winnowed from glacial lake deposits also served as an important source of clasts for the Bighill Creek Formation. Occurrences on other rivers, including the South Saskatchewan, North Saskatchewan, Athabasca, and Peace systems, are introduced to show that they present similarities in age, fauna, sedimentology and (possibly) genesis to the Bighill Creek Formation. They are therefore viewed as correlative equivalents if not the same unit; and radiocarbon dates currently available suggest that the deposits are slightly younger northward. Faunal similarities across drainages are introduced; in particular a large form of bison (Bison sp., cf. B. bison antiquus) appears to have value as an index fossil. The late Pleistocene extinctions either coincided with cessation of Bighill Creek Formation deposition or, more likely, were under way during its closing stages.

Location: AEU, SCI, QE 696. C82 1984
AEPAA, 551.79 Q29
Areas: Map area - 72 L, 82 H, 82 I, 82 O, 82 P, 83 H, 83 I, 83 M, 83 N, 84 C
Borden areas - DP, EO, EP, FP, GP, GQ, HQ
Topics: Faunal remains - Bison, Faunal remains - Camelops, Faunal remains - Equus, Faunal remains - Mammuthus, Faunal remains - Ovis, Faunal remains - Rangifer, Geomorphology - terraces, Paraglacial landforms

Wilson, M.C., and C.S. Churcher
1978 Late Pleistocene Camelops from the Gallelli Pit, Calgary, Alberta: Morphology and Geologic Setting. Canadian Journal of Earth Sciences 15:729-740.

A radiocarbon-dated gravel deposit in Calgary, Alberta, has yield a large humerus referred to the extinct camelid, Camelops cf. hesternus. With a date of 11 300±290 BP (RL-757) this is the first securely dated postglacial record of Camelops in Canada. Studies of the gravels show them to represent a period of rapid aggradation by a braided river, subsequent to the drainage of glacial Lake Calgary. The gravels are equivalent in age and characteristics to the Bighill Creek Formation of the Cochrane area, 30 km west of Calgary; and are therefore assigned to that formation. Later fill units are, however, excluded from the formation as they represent Holocene cut-and-fill events of differing hydrologic significance. Recent suggestions that Lake Calgary persisted until 9000 years BP can now be rejected on the basis of stratigraphy and radiocarbon dates. Studies of the camel humerus suggest some revisions in our views concerning morphologic variation in the species: the species was probably more plastic than has been accepted to date. Associated Bison bison antiquus and Equus conversidens from the same gravels (Gallelli and Galvin Pits) are briefly described. The ungulate fauna from these pits suggests a semiforest habitat with extensive scrub and grassland elements.

Location : AEU, SCI, QE 1. C212
AEPAA and ADTMP, Periodicals collection
Areas : Map area - 82 J
Borden areas - EP
Topics : Faunal remains - Bison, Faunal remains - Camelops, Faunal remains - Equus

d. Northern Western Corridor

Burns, J.A.

1986 A 9000-year Old Wapiti (Cervus elaphus) Skeleton from Northern Alberta, and its Implications for Early Holocene Environment. Géographie physique et Quaternaire 40:105-108.

A complete and fully articulated adult male wapiti (Cervus elaphus) skeleton was recovered from the 50 m terrace of Smoky River, near Watino, Alberta. A collagen-based date on antler gave an age of 9075±305 yr BP (S-2614). The local terrace sequence features three benches, and two previously described fossil sites are placed within it. The importance of the find is that it indicates an environment at 9000 yr BP similar to present. A brief review of local deglaciation precedes discussion of the paleontology.

Location : AEU, PMC, G 1. R452
Areas : Map area - 83 N
Borden areas - GQ
Topics : Faunal remains - Cervus

Churcher, C.S., and M.C. Wilson

1979 Quaternary Mammals from the Eastern Peace River District, Alberta. Journal of Paleontology 53:71-76.

Six genera and ten species of mammals have been obtained from post-glacial gravels of the eastern Peace River District, Alberta. The gravels are exposed in borrow pits or river bluffs and comprise a post-glacial high mantling sheet north and west of Peace River - and three or four terraces in the valleys of the Smoky and Peace rivers. Gravels older than mid-Wisconsin are recognised at Watino on the Smoky River. Extinct post-glacial taxa are Mammuthus primigenius, Equus cf. E. conversidens, E. cf. E. niobrarensis, Bison priscus, B. b. occidentalis, a camelid, possibly Hemiauchenia or Camelops; extant taxa are Cervus canadensis, Bison b. athabascae, B. b. bison, and Ovibos cf. O. moschatus. Remains of four genera and five species have been obtained from Sangamon or earlier deposits at Watino on the Smoky River. These represent Spermophilus sp., a proboscidean, Equus sp. small, E. cf. E. niobrarensis, and Bison sp. Both these faunas may have existed in either a predominantly plains environment or in an aspen poplar parkland, but not in continuous boreal forest.

Location : AEU, SCI, QE 701. J86
AEPAA, Periodicals collection
Areas : Map area - 83 K, 83 M, 83 N, 84 C, 84 D
Borden areas - GQ, HQ
Topics : Faunal remains - Bison, Faunal remains - Camelops, Faunal remains - Cervus, Faunal remains - Equus, Faunal remains - Hemiauchenia, Faunal remains - Mammuthus, Faunal remains - Ovibos, Faunal remains - Spermophilus

e. Southeastern Alberta and Southern Saskatchewan

Churcher, C.S.

1972 Imperial Mammoth and Mexican Half-ass from near Bindloss, Alberta. Canadian Journal of Earth Sciences 9:1562-1567.

Mammals recovered from gravels lying about 100 ft (30 m) above the level of the Red Deer River on Highway 41, halfway between Bindloss and Empress, now comprise Mammuthus imperator and Equus (Asinus) conversidens in addition to the lion-like cat (Panthera atrox) previously recorded from the site. A post-Wisconsin age of greater than 8000 years B.P. is suggested for the deposit.

Location : AEU, SCI, QE 1. C212
AEPAA and ADTMP, Periodicals collection
Areas : Map area - 72 L
Borden areas - EO
Topics : Faunal remains - Equus, Faunal remains - Mammuthus, Faunal remains - Panthera

Churcher, C.S., and A. MacS. Stalker

1970 A Late, Postglacial Horse from Pashley, Alberta. Canadian Journal of Earth Sciences 7:1020-1026.

Elements from the left hind foot of a small horse, probably Equus conversidens Owen, are reported from a few miles southeast of Medicine Hat, Alberta. The bones were found below a buried soil contained within an eastward-striking glacial spillway. A date of about 8000 y B.P. is suggested for the specimens on stratigraphic considerations. If this date is correct, these bones probably represent the youngest indigenous fossil horse known in North America.

Location : AEU, SCI, QE 1. C212
AEPAA and ADTMP, Periodicals collection
Areas : Map area - 72 E
Borden areas - DO
Topics : Faunal remains - Equus, Palaeosols

Harington, C.R.

1971 A Pleistocene Lion-like Cat (Panthera atrox) from Alberta. Canadian Journal of Earth Sciences 8:170-174.

A tooth-bearing facial fragment of the extinct cat Panthera atrox is described. The specimen, from Pleistocene gravels near Bindloss, Alberta, extends the known northward range of this species on the Great Plains. Although the exact geological age of the specimen is uncertain, occurrences of P. atrox elsewhere suggest its presence in southeastern Alberta during a relatively warm phase of the Late Pleistocene.

Location : AEU, SCI, QE 1. C212
AEPAA and ADTMP, Periodicals collection
Areas : Map area - 72 L

Borden areas - EO

Topics: Faunal remains - Equus, Faunal remains - Mammuthus, Faunal remains - Panthera

f. Central and East-Central Alberta

Fuller, W.A., and L.A. Bayrock

1965 Late Pleistocene Mammals from Central Alberta, Canada. In Vertebrate Paleontology in Alberta, edited by R.E. Folinsbee and D.M. Ross, pp. 53-63. University of Alberta, Department of Geology, Bulletin No. 2, Edmonton, Alberta.

For the past decade gravel-pit operators in the vicinity of Edmonton, Alberta, Canada, have been co-operating with the Research Council and the University of Alberta in the recovery of fossil bones. This collection has recently been studied and the results are reported in this paper.

Fossils of Pleistocene age mammals are found mainly in two distinct types of deposits in Alberta: (a) in post-glacial alluvial deposits of the terraces along the major streams and (b) in Saskatchewan gravels and sands. The terrace deposits are all post-glacial in age.

The Saskatchewan gravels and sands are valley fills of preglacial rivers. Lithologically these deposits are very distinct from glacial deposits in that they do not contain any material derived by glaciers from the Canadian Shield to the northeast, such as granites and metamorphic rocks. On this basis the gravels and sands are called pre-glacial in that they predate glacierization of the country as has been determined previously, e.g. McConnell (1885), Tyrrell (1886), Coleman (1909), Rutherford (1937).

Fossils of Equus sp., about 10% smaller than E. caballus, and Mammuthus? sp. found in Saskatchewan gravel and sand deposits strongly suggest a late Pleistocene age for the deposit. Some wood found in association with the Equus sp. bones is being currently C^{14} dated.

Buried valleys containing the Saskatchewan gravels and sand deposits have been outlined for most of Alberta and Saskatchewan. They form a continuous dendritic pattern terminating at the border of the Canadian Shield beyond which it is not possible to trace them.

Buried periglacial distortions of the Saskatchewan gravels and sands, specifically in the Edmonton area (Westgate and Bayrock, 1964) suggest that latest deposition took place during a glacial rather than an interglacial period.

From the foregoing it is postulated that most of Alberta, Saskatchewan and large parts of the Northwest Territories were subjected to continental glacierization only once during the Pleistocene period, and that during the Wisconsin. At previous glacial stages the country was free of ice and presented an open route for migration of animals from Asia to North America and vice versa.

Abstract :	Authors' General Statement
Location :	ADTMP, QE 841. V617A ARC, Contribution Series 296
Areas :	Map area - 83 H Borden areas - FP
Topics :	Buried valleys, Faunal remains - Equus, Faunal remains - Mammuthus, Plant macrofossils - wood, Quaternary stratigraphy - Saskatchewan gravels and sands, Review of faunal studies

Harington, C.R.

1975 Pleistocene Muskoxen (Symbos) from Alberta and British Columbia. Canadian Journal of Earth Sciences 12:903-919.

Skull fragments of the extinct muskox Symbos cavifrons from late Pleistocene gravels at Fort Saskatchewan and Saanich Peninsula, Vancouver Island are the first records of that species for Alberta and British Columbia respectively. The Alberta specimen shows that Symbos herds once grazed along the eastern flanks of the Rocky Mountains.

The discovery of a muskox fossil (and remains of other ice age land mammals) on southeastern Vancouver Island suggests that land connected the island with the mainland during the late Pleistocene. Causes for such a land connection or connections are considered.

Location : AEU, SCI, QE 1. C212
AEPAA and ADTMP, Periodicals collection
Areas : Map area - 83 H, Vancouver Island
Borden areas - FP, region as above
Topics : Faunal remains - Symbos

Storer, J.E.

1976 Mammals of the Hand Hills Formation, Southern Alberta. In Athlon: Essays on Palaeontology in Honour of Loris Shano Russell, edited by C.S. Churcher, pp. 186-209. Miscellaneous Publications, Life Sciences, Royal Ontario Museum, Toronto, Ontario.

Fossil mammals of two different ages occur in the Hand Hills Formation of southern Alberta: Merychippus sp., Hipparion sp., Camelidae, gen. et sp. indet., Sciurinae, gen. et sp. indet., Copemys sp., and Pseudadjidaumo cf. russelli are of latest Miocene or earliest Pliocene age; and Elephantidae, gen. et sp. indet., Equus cf. conversidens, Spermophilus cf. richardsonii, Microtus cf. pennsylvanicus, Geomys sp., and Leporidae, gen. et sp. indet., are of Irvingtonian or later age. The Hand Hills Formation comprises a single unit, including in places a layer of till, and contains a mixed mammalian fauna whose temporal components are not separated by a stratigraphic marker.

Note : The Pleistocene material is most likely Late Wisconsinan in age based on new AMS dates from the Hand Hills (J.A. Burns, pers. comm., 1988).
Location : AEU, SCI, QE 723. A87 1976
ADTMP, QE 723. At46
Areas : Map area - 82 P
Borden areas - EP
Topics : Faunal remains

g. Northeastern British Columbia

Driver, J.C.

1988 Late Pleistocene and Holocene Vertebrates and Palaeoenvironments from Charlie Lake Cave, Northeast British Columbia. Canadian Journal of Earth Sciences 25:1545-1553.

Excavations outside Charlie Lake Cave, Peace River District, British Columbia, revealed deposits dating from ~10 700 BP to the present. The earliest fauna (10 700 - 10 000 BP) was deposited when the newly deglaciated landscape was largely unforested and included bison (Bison sp.), ground squirrel (Spermophilus sp.), a large hare (Lepus sp.), snowshoe hare (Lepus americanus), and a variety of birds, including the Cliff Swallow (Hirundo pyrrhonota). By 10 000 BP snowshoe hare (Lepus americanus) was the most numerous mammal, indicating the development of forested conditions. By 9000 BP the fauna resembled the modern Peace River fauna prior to European settlement, typical of a largely forested landscape, with wetland areas indicated by aquatic avian species. Subsequent Holocene climatic fluctuations are not evident in the faunal record.

Location : AEU, SCI, QE 1. C212
AEPAA and ADTMP, Periodicals collection
Areas : Map areas - British Columbia - Northeastern
Borden areas - region as above
Topics : Faunal remains - Bison, Faunal remains - Hirundo, Faunal remains - Lepus, Faunal remains - Spermophilus

Fladmark, K.R., J.C. Driver, and D. Alexander

1988 The Paleoindian Component at Charlie Lake Cave (HbRf 39), British Columbia. American Antiquity 53:371-384.

Charlie Lake Cave (HbRf 39) is a stratified site in northeastern British Columbia, Canada, containing a fluted point component at the base of the excavated deposits. The small artifact assemblage includes a fluted point, stone bead, core tool, and retouched flake. A diverse associated fauna includes fish, birds, and mammals, indicating a more open environment than exists today. Radiocarbon dates suggest that the artifact assemblage was deposited about 10,500 years ago.

Location : AEPAA, Periodicals collection
Areas : Map area - 94 A, British Columbia - Northeastern
Borden areas - HR
Topics : Archaeological sites - HbRf-39, Artifacts, Cave deposits, faunal remains

Rutter, N.W., V. Geist, and D.M. Shackleton

1972 A Bighorn Sheep Skull 9280 Years Old from British Columbia. Journal of Mammalogy 53:641-644.

... The skull of the male sheep reported on in this paper is of particular significance, because it is the second date sheep occurrence to be reported and because it can be placed in relation to the melt-off of Cordilleran ice in the Rocky Mountains, thus shedding light on the post-glacial dispersal of sheep. ...

Abstract : Section Authors' text
Location : AEU, SCI, QL 700. J86
Areas : Map area - British Columbia - Northeastern
Borden areas - region as above
Topics : Faunal remains - *Ovis*

h. Northern United States

Harington, C.R., and A.C. Ashworth

1986 A Mammoth (Mammuthus primigenius) Tooth from Late Wisconsin Deposits near Embden, North Dakota, and Comments on the Distribution of Woolly Mammoths South of the Wisconsin Ice Sheets. Canadian Journal of Earth Sciences 23:909-918.

A well-preserved third molar of a woolly mammoth (Mammuthus primigenius) was recovered from sand and gravel forming the highest (Herman) prominent strandline of Lake Agassiz near Embden in western Cass County, North Dakota. The Herman strandline is estimated to have formed about 11 500 years BP, and presumably the tooth is of similar age. Perhaps the animal lived in a tundra-like area near the Lake Agassiz shoreline.

Additional evidence suggests that woolly mammoths occupied a tundra-like range south of the Wisconsin ice sheets extending from southern British Columbia to the Atlantic continental shelf off Virginia.

Location : AEU, SCI, QE 1. C212
AEPAA and ADTMP, Periodicals collection
Areas : Map area - 72 L, 82 P, British Columbia - Central, Manitoba - Southern, North Dakota, Ontario - Southern, Saskatchewan - Southern, United States - Northern
Borden areas - EO, FP, regions as above
Topics : Faunal remains - Mammuthus

SECTION B. SHORT NOTES

PART 1. LATE QUATERNARY GEOLOGY

a. Southern Western Corridor

Harrison, J.E.
1976 **Dated Organic Material Below Mazama (?) Tephra: Elk Valley, British Columbia. Report of Activities, Part C, Geological Survey of Canada Paper 76-1C:169-170.**

Location : AEU, SCI, QE 185. C2
Areas : Map areas - 82 J, British Columbia - Elk Valley
Borden areas - EP, region as above
Topics : Analysis of radiocarbon dates, Pollen analysis, Tephra - Mazama

Horberg, L.
1952 **Quaternary Volcanic Ash in Southern Alberta, Canada. Science 115:140-141.**

Abstract : No abstract available
Location : AEU, SCI, Q 1. S41
Areas : Map areas - 82 H
Borden areas - DP
Topics : Tephra - mineralogy, Tephra - undetermined source

Jackson, Jr., L.E.
1976 **Quaternary Geology and Terrain Inventory, Kananaskis Lakes (82 J), East of the Continental Divide, Alberta. Report of Activities, Part A, Geological Survey of Canada Paper 76-1A:209-211.**

Location : AEU, SCI, QE 185. C2
Areas : Map areas - 82 J
Borden areas - EP
Topics: Erratics Train, Glacial lake sequences, Quaternary stratigraphy

Jackson, Jr., L.E.
1975 **Quaternary Geology and Terrain Inventory, Kananaskis Lakes, 82 J, East of the Continental Divide, Alberta. Report of Activities, Part A, Geological Survey of Canada Paper 75-1A:412.**

Location : AEU, SCI, QE 185. C2
Areas : Map areas - 82 J
Borden areas - EP
Topics : Quaternary stratigraphy

Stalker, A. MacS.

1976 Megablocks, or the Enormous Erratics of the Albertan Prairies. Report of Activities, Part C, Geological Survey of Canada Paper 76-1C:185-188.

Location: AEU, SCI, QE 185. C2
Areas: Map areas - 72 E, 82 H, 83 H
Borden areas - DO, DP, FP
Topics: Bedrock blocks

Stalker, A. MacS.

1975 The Large Interdrift Bedrock Blocks of the Canadian Prairies. Report of Activities, Part A, Geological Survey of Canada Paper 75-1A:421-422.

Location: AEU, SCI, QE 185. C2
Areas: Map areas - 82 H
Borden areas - DP
Topics: Bedrock blocks

Stalker, A. MacS.

1966 Glacial Geology Studies in Southern and Central Alberta. Report of Activities, Geological Survey of Canada Paper 66-1:123.

Location: AEU, SCI, QE 185. C2
Areas: Map areas - 82 J
Borden areas - EP
Topics: Erratics train, Quaternary stratigraphy

Stalker, A. MacS.

1964 Glacial Geology Studies in Southern and Central Alberta. Report of Activities, Canada Geological Survey Paper 65-1:83.

Location: AEU, SCI, QE 185. C2
Areas: Map areas - 72 L, 82 I, 82 J
Borden areas - EO, EP
Topics: Buried valleys, Erratics Train, Quaternary stratigraphy

Stalker, A. MacS.

1963 Surficial Geology, Bassano Map-Area. Summary of Activities, Canada Geological Survey Paper 64-1:36.

Location: AEU, SCI, QE 185. C2
Areas: Map areas - 82 I
Borden areas - EP
Topics: Quaternary stratigraphy

Stalker, A. MacS.

1963 Surficial Geology, Blood Indian Reserve. Summary of Research, Field, 1962, Geological Survey of Canada Paper 63-1:35.

Location: AEU, SCI, QE 185. C2
Areas: Map areas - 82 H
Borden areas - DP
Topics: Glacial lake sequences, Quaternary stratigraphy

b. Central Western Corridor

Harrison, J.E.

1973 Dated Paleosol from below Mazama(?) Tephra. Current Research Part B, Geological Survey of Canada Paper 73-1B:127-128.

Location : AEU, SCI, QE 185. C2
Areas : Map areas - 82 O
Borden areas - EP
Topics : Palaeosols, Tephra - Mazama

McLaren, P., and N.W. Rutter

1972 Quaternary Geology, Bow River Valley (Parts of 82 J, O). Report of Activities, Part A, Geological Survey of Canada Paper 72-1A:170.

Location : AEU, SCI, QE 185. C2
Areas : Map areas - 82 J, 82 O
Borden areas - EP
Topics : Quaternary stratigraphy

Rutter, N.W.

1969 Surficial Geology Along the Bow River Valley in the Vicinity of Calgary, Alberta (82 O). Report of Activities, Part A, Geological Survey of Canada Paper 69-1A:215-216.

Location : AEU, SCI, QE 185. C2
Areas : Map areas - 82 O
Borden areas - EP
Topics : Drilling, Quaternary stratigraphy

Rutter, N.W.

1968 Surficial Geology Along the Bow River Valley in the Vicinity of Calgary, Alberta (82 O). Report of Activities, Part A, Geological Survey of Canada Paper 68-1A:181-182.

Location : AEU, SCI, QE 185. C2
Areas : Map areas - 82 O
Borden areas - EP
Topics : Quaternary stratigraphy, Tephra

Rutter, N.W.

1967 Surficial Geology Along the Bow River Valley Between the Kananaskis River and Cochrane. Report of Activities, Part A, Geological Survey of Canada Paper 67-1A:113.

Location : AEU, SCI, QE 185. C2
Areas : Map areas - 82 O

Borden areas - EP
Topics: Palaeosols, Quaternary stratigraphy, Tephra

c. Northern Western Corridor

St-Onge, D.A.

1972 Tawatinaw Map Area Geology. In Soil Survey of the Tawatinaw Sheet (83-I), A.A. Kjearsgaard, pp. 93-95. Alberta Soil Survey Report 29, Canada Department of Agriculture, Soil Survey Research Institute, Edmonton.

The Tawatinaw map-area in north-central Alberta was overridden at least twice by the continental ice-sheet so that the area is mantled by drift ranging in thickness from a few feet to over 190 ft. Bedrock outcrops are scarce except in the southwest corner of the area where drift thickness is generally less than 10 ft. Bedrock outcrops are found also along the steep valley walls of the Athabasca and North Saskatchewan rivers.

Location : AEU, SCI, S 599.1 A3 A33 No. 29 1972
Areas : Map areas - 83 I
Borden areas - GP
Topics : Glacial geomorphology, Quaternary stratigraphy

St-Onge, D.A.

1970 Quaternary Geology and Geomorphology of the Tawatinaw Area, Alberta (83 I). Report of Activities, Part A, Geological Survey of Canada Paper 70-1A:183-184.

Location : AEU, SCI, QE 185. C2
Areas : Map areas - 83 I
Borden areas - GP
Topics : Analysis of radiocarbon dates, Drilling, Faunal remains - Bison, Quaternary stratigraphy

St-Onge, D.A.

1966 Geomorphology and Glacial Geology Studies in North-Central Alberta. Report of Activities, Geological Survey of Canada Paper 66-1:122.

Location : AEU, SCI, QE 185. C2
Areas : Map areas - 83 K
Borden areas - GQ
Topics : Glacial lake sequences, Quaternary stratigraphy

d. Southeastern Alberta and Southern Saskatchewan

Barendregt, R.W., J.H. Foster, and A. MacS. Stalker
1977 Paleomagnetic Remanence Characteristics of Surface Tills Found in the Pakowki-Pinhorn Area of Southern Alberta. Report of Activities, Part B, Geological Survey of Canada Paper 77-1:271-272.

Location : AEU, SCI, QE 185. C2
Areas : Map areas - 72 E
Borden areas - DO
Topics : Palaeomagnetism

Barendregt, R.W., and A. MacS. Stalker
1978 Characteristic Magnetization of Some Middle Pleistocene Sediments from the Medicine Hat Area of Southern Alberta. Scientific and Technical Notes, Current Research, Part A, Geological Survey of Canada Paper 78-1A:487-488.

Location : AEU, SCI, QE 185. C2
Areas : Map areas - 72 L
Borden areas - EO
Topics : Palaeomagnetism

Barendregt, R.W., A. MacS. Stalker, and J.H. Foster
1976 Differentiation of Tills in the Pakowki-Pinhorn Area of Southeastern Alberta on the Basis of their Magnetic Susceptibility. Report of Activities, Part C, Geological Survey of Canada Paper 76-1C:189-190.

Location : AEU, SCI, QE 185. C2
Areas : Map areas - 72 E
Borden areas - DO
Topics : Palaeomagnetism

Foster, J.H., and A. MacS. Stalker
1976 Paleomagnetic Stratigraphy of the Wellsch Valley Site, Saskatchewan. Report of Activities, Part C, Geological Survey of Canada Paper 76-1C:191-193.

Location : AEU, SCI, QE 185. C2
Areas : Map areas - Saskatchewan - Wellsch Valley
Borden areas - region as above
Topics : Faunal remains, Palaeomagnetism

Klassen, R.W.
1984 Quaternary Geology of Southwestern Saskatchewan. Current Research, Part A, Geological Survey of Canada Paper 84-1A:641-642.

Three surface tills occur in the Cypress Hills area of southwestern Saskatchewan. A paleosol in till and loess suggests that the till plain in the east-central part predates the last glaciation, as does a quartzite-rich till on pediments flanking the Cypress Hills in the northwestern part. The youngest till forms a hummocky moraine along the northwestern margin of the area.

Location : AEU, SCI, QE 185. C2
Areas : Map areas - 72 F, Saskatchewan - Cypress Hills
Borden areas - DO, region as above
Topics : Palaeosols, Quaternary stratigraphy

Stalker, A. MacS.
1972 Quaternary Studies in the Southwestern Prairies. Report of Activities, Part A, Geological Survey of Canada Paper 72-1A:136.

Location : AEU, SCI, QE 185. C2
Areas : Map areas - 72 L, Saskatchewan - Wellsch Valley
Borden areas - EO, region as above
Topics : Quaternary stratigraphy, Faunal remains

Stalker, A. MacS.
1971 Quaternary Studies in the Southwestern Prairies. Report of Activities, Part A, Geological Survey of Canada Paper 71-1A:180-181.

Location : AEU, SCI, QE 185. C2
Areas : Map areas - 72 L
Borden areas - EO
Topics : Faunal remains, Quaternary stratigraphy, Tephra

Stalker, A. MacS.
1970 Quaternary Studies in the Southwestern Prairies, Alberta (72L East Half). Report of Activities, Part A, Geological Survey of Canada Paper 70-1A:187-188.

Location : AEU, SCI, QE 185. C2
Areas : Map areas - 72 L
Borden areas - EO
Topics : Drilling, Faunal remains, Quaternary stratigraphy

Stalker, A. MacS.
1969 Quaternary Studies in the Southwestern Prairies, Alberta. Report of Activities, Part A, Geological Survey of Canada Paper 69-1A:220-221.

Location : AEU, SCI, QE 185. C2
Areas : Map areas - 72 L, Saskatchewan - Wellsch Valley
Borden areas - EO, region as above
Topics : Faunal remains, Quaternary stratigraphy

Stalker, A. MacS.

1968 Quaternary Studies in the Southwestern Prairies. Report of Activities, Part A, Geological Survey of Canada Paper 68-1A:184-186.

Location : AEU, SCI, QE 185. C2
Areas : Map areas - 72 L, 82 H, Saskatchewan - Wellsch Valley
Borden areas - DP, EO, region as above
Topics : Faunal remains, Quaternary stratigraphy

Stalker, A. MacS.

1967 Quaternary Studies in the Southwestern Prairies. Report of Activities, Part A, Geological Survey of Canada Paper 67-1A:113-114.

Location : AEU, SCI, QE 185. C2
Areas : Map areas - 72 L, 82 H, Saskatchewan - Southern
Borden areas - DP, EO, region as above
Topics : Archaeological sites - DkPj-1, Faunal remains, Quaternary stratigraphy

e. Northern Alberta

St-Onge, D.A.
1969 Quaternary Geology and Geomorphology of the Whitecourt and Tawatinaw Area, Alberta (83 I, J). Report of Activities, Part A, Geological Survey of Canada Paper 69-1A:217.

Location : AEU, SCI, QE 185. C2
Areas : Map areas - 83 I, 83 J
Borden areas - GP
Topics : Plant macrofossils - wood, Quaternary stratigraphy

St-Onge, D.A.
1968 Quaternary Geology and Geomorphology, Whitecourt (83-J) Map-area. Report of Activities, Part A, Geological Survey of Canada Paper 68-1A:186-188.

Location : AEU, SCI, QE 185. C2
Areas : Map areas - 83 J
Borden areas - GP
Topics : Faunal remains, Molluscs, Plant macrofossils - seeds, Plant macrofossils - wood, Quaternary stratigraphy, Quaternary stratigraphy - Saskatchewan gravels and sands

St-Onge, D.A.
1967 Quaternary Geology and Geomorphology, Whitecourt (83-J) Map-area. Report of Activities, Part A, Geological Survey of Canada Paper 67-1A:115-117.

Location : AEU, SCI, QE 185. C2
Areas : Map areas - 83 J
Borden areas - GP
Topics : Quaternary stratigraphy

f. Northeastern British Columbia

Mathews, W.H.

1973 Quaternary Geology, Charlie Lake, British Columbia. Report of Activities, Part A, Geological Survey of Canada Paper 73-1A:210-211.

Location: AEU, SCI, QE 185. C2
Areas: Map areas - British Columbia - Northeastern
Borden areas - region as above
Topics: Glacial chronology, Glacial lake sequences, Quaternary stratigraphy, Till - lithology

Mathews, W.H.

1972 Quaternary Geology, Charlie Lake, British Columbia (94 A). Report of Activities, Part A, Geological Survey of Canada Paper 72-1A:169-170.

Location: AEU, SCI, QE 185. C2
Areas: Map areas - 94 A, British Columbia - Northeastern
Borden areas - HR, region as above
Topics: Quaternary stratigraphy

Reimchen, T.H.F., and N.W. Rutter

1972 Quaternary Geology, Dawson Creek, British Columbia (93 P). Report of Activities, Part A, Geological Survey of Canada Paper 72-1A:176-177.

Location: AEU, SCI, QE 185. C2
Areas: Map areas - 93 P, British Columbia - Northeastern
Borden areas - GR, region as above
Topics: Faunal remains - Equus, Faunal remains - Mammuthus, Glacial lake sequences, Quaternary stratigraphy

Rutter, N.W.

1971 Quaternary Geology, Pine Pass, British Columbia-Jasper, Alberta. Report of Activities, Part A, Geological Survey of Canada Paper 71-1A:178-179.

Location: AEU, SCI, QE 185. C2
Areas: Map areas - British Columbia - Northeastern
Borden areas - region as above
Topics: Glacial lake sequences, Quaternary stratigraphy

Rutter, N.W.

1970 Quaternary Geology, Pine Pass, British Columbia-Jasper, Alberta (Parts of 83, 93). Report of Activities, Part A, Geological Survey of Canada Paper 70-1A:183.

Location: AEU, SCI, QE 185. C2
Areas: Map areas - British Columbia - Northeastern
Borden areas - region as above

Topics: Quaternary stratigraphy

Rutter, N.W.

1969 **Surficial Geology of the Peace River Dam and Reservoir Area, British Columbia (Parts of 93N, O, 94B, C, E). Report of Activities, Part A, Geological Survey of Canada Paper 69-1A:216-217.**

Location: AEU, SCI, QE 185. C2
Areas: Map areas - 93 N, 93 O, 94 B, 94 C, 94 E, British Columbia - Northeastern
Borden areas - GR, region as above
Topics: Quaternary stratigraphy

Rutter, N.W.

1968 **Surficial Geology of the Peace River Dam and Reservoir Area, British Columbia. Report of Activities, Part A, Geological Survey of Canada Paper 68-1A:182-183.**

Location: AEU, SCI, QE 185. C2
Areas: Map areas - British Columbia - Northeastern
Borden areas - region as above
Topics: Quaternary stratigraphy

Rutter, N.W., and G.V. Minning

1972 **Surficial Geology and Land Classification Mackenzie Valley Transportation Corridor (85 E, 95 A, B (South Half), H, J). Report of Activities, Part A, Geological Survey of Canada Paper 72-1A:178.**

Location: AEU, SCI, QE 185. C2
Areas: Map areas - 85 E, 95 A, 95 B, 95 H, 95 J, Northwest Territories
Borden areas - region as above
Topics: Glacial lake sequences, Quaternary stratigraphy

PART 2. LATE QUATERNARY PALAEOENVIRONMENTS

a. Southeastern Alberta and Southern Saskatchewan

Mott, R.J., and A. MacS. Stalker
1972 Palynology of the "Kansan" Carbonaceous Clay Unit Near Medicine Hat, Alberta. Report of Activities, Part B, Geological Survey of Canada Paper 72-1B:117-119.

Location : AEU, SCI, QE 185. C2
Areas : Map areas - 72 L
Borden areas - EO
Topics : Faunal remains, Plant macrofossils - wood, Pollen analysis

b. Central and East-Central Alberta

Lichti-Federovich, S.

1972 **Pollen Stratigraphy of a Sediment Core From Alpen Siding Lake, Alberta. Report of Activities, Part B, Geological Survey of Canada Paper 72-1B:113-115.**

Location : AEU, SCI, QE 185. C2
Areas : Map areas - 83 I
Borden areas - GP
Topics : Pollen analysis, Vegetation history

c. Northern Alberta

Lichti-Federovich, S.

1975 Plant Megafossils from Mid-Wisconsin Sediments in West-central Alberta. Report of Activities, Part C, Geological Survey of Canada Paper 75-1C:85-90.

Location : AEU, SCI, QE 185. C2
Areas : Map areas - 83 N
Borden areas - GQ
Topics : Plant macrofossils - needles, Plant macrofossils - seeds

Mott, R.J.

1974 Quaternary Palynology, Alberta and Quebec. Report of Activities, Part A, Geological Survey of Canada Paper 74-1A:213.

Location : AEU, SCI, QE 185. C2
Areas : Map areas - 83 N, 83 P, 84 D
Borden areas - GP, GQ, HQ
Topics : Lake cores, Pollen analysis

PART 3. LATE QUATERNARY PALAEONTOLOGY

a. Southern Western Corridor

Brulotte, R.
1983 Excavations in the Foothills of Alberta. ZooArchaeological Research News 2(1):11-12.

Location : IC
Areas : Map areas - 82 G
Borden areas - DP
Topics : Archaeological sites - DkPp-11, Cave deposits, Faunal remains

Storer, J.E.
1975 Pleistocene Prairie Dog in South-central Alberta. Blue Jay 33:247-248.

Location : AEU, SCI, QH 1. B65
Areas : Map areas - 82 P
Borden areas - EP
Topics : Faunal remains, Faunal remains - Cynomys

Storer, J.E.
1972 Mammals of the Hand Hills Formation of Southern Alberta: Preliminary Faunal List. Blue Jay 30:119-120.

Location : AEU, SCI, QH 1. B65
Areas : Map areas - 82 P
Borden areas - EP
Topics : Faunal remains

b. Southeastern Alberta and Southern Saskatchewan

Churcher, C.S.

1974 Studies on Quaternary Sites at Wellsch Valley and Lancer, Saskatchewan, and Heather Coulee, Near Irvine, Alberta. Report of Activities. Part B, Geological Survey of Canada Paper 74-1B:212-214.

Location : AEU, SCI, QE 185. C2
Areas : Map areas - 72 E, 72 L, Saskatchewan - Wellsch Valley
Borden areas - DO, EO, region as above
Topics : Faunal remains

Churcher, C.S.

1970 The Vertebrate Faunas of Surprise, Mitchell, and Island Bluffs, Near Medicine Hat, Alberta (72 L). Report of Activities, Part A, Geological Survey of Canada Paper 70-1A:158-160.

Location : AEU, SCI, QE 185. C2
Areas : Map areas - 72 L
Borden areas - EO
Topics : Faunal remains

SECTION C. THESES

PART 1. LATE QUATERNARY GEOLOGY

a. Southern Western Corridor

Alley, N.F.

1972 The Quaternary History of Part of the Rocky Mountains, Foothills, Plains and Western Porcupine Hills, Southwestern Alberta. Unpublished Ph.D. dissertation, Department of Geography, University of Calgary, Calgary, Alberta. (201 pp.)

The Quaternary deposits occurring approximately between the Porcupine Hills and the Continental Divide in southwestern Alberta were investigated and mapped in detail to determine the sequence of events. The program included lithological and fabric analysis. Pollen and faunal remains recovered from the nontill units aided in determining the ages of drift and climatic changes.

There are three major glacial events of decreasing magnitude in the area, an event consisting of one Mountain and one Laurentide advance. The Albertan (oldest), Cowley (new name) and Gap (new name) tills were deposited by the Mountain glaciers. Advances of Laurentide ice deposited the Pincher (oldest), Maunsell and Beaver Creek tills. During each event, the Mountain glaciers reached their maxima and receded considerably prior to the advance of the Laurentide ice sheets. The Saskatchewan Sands and Gravels, consisting of preglacial boulders and an upper facies of proglacial sediments, underlie the oldest tills. These gravels are exposed along major preglacial channels east of the Livingstone Range. The distribution of moraines in conjunction with pollen data indicates that 2 minor glaciations, subsequent to Event 3, occurred in the Mountains. The earlier advance led to the deposition of the Cache Creek till (new name) and the later, to cirque moraines.

Proglacial lakes developed from local ponding by valley glaciers, or from extensive damming by Laurentide ice sheets. Sediments deposited in these lakes separate the tills or occur at the surface. Prominent terraces along the Oldman and Crowsnest Rivers in the Foothills were adjusted to the level of the last proglacial lake (event 3) to occupy the study area.

Stratigraphic and palynologic evidence shows that there are 2 periods of preWisconsin and one of Early Wisconsin deposition to the east in the Lethbridge area. These are correlative with the Laurentide Pincher, Maunsell and Beaver Creek tills and the Albertan, Cowley and Gap drifts respectively. The Cache Creek advance is Classical Wisconsin based on a radiocarbon date (22,700±1,000 years B.P., GaK-2336) from bone underlying the outwash, and the Mazama tephra occurring upstream from the end moraines. Pollen data and the moraines in close proximity to cirques indicate that the last glacial event is correlative with the Neoglacial.

The distribution and stratigraphy of drift sheets infers that the study area east of the Livingstone Range was ice-free during the Classical Wisconsin and Recent. A feature of the period was the deposition of gravels and alluvium along major streams in this zone. Pollen and mollusca recovered from bog and alluvial sediments indicate that prior to the Neoglacial (i.e., between ca. 5 to 11,000 years B.P.) the climate ameliorated. This interval is correlative with the Altithermal.

Location : ACU, UARC, ID#1712
ACU, Mic., QE 696. A44 1972
Areas : Map areas - 82 G, 82 H, 82 I, 82 J

Borden areas - DP, EP
Topics: Glacial chronology, Glacial lake sequences, Molluscs, Pollen analysis, Quaternary stratigraphy, Tephra - Mazama

Day, D.L.
1971 The Glacial Geomorphology of the Trout Creek Area, Porcupine Hills, Alberta. Unpublished Masters thesis, Department of Geography, University of Calgary, Calgary, Alberta. (158 pp.)

This study is an examination of the glacial geomorphology of the Trout Creek drainage basin of the Porcupine Hills, west of Claresholm, Alberta.

There is evidence for two Laurentide ice advances into the area based on the distribution of tills and erratics, and the results of field and laboratory analyses. During the retreat of the latest ice sheet, lacustrine sediments were deposited in the valley of Trout Creek between 4,200 and 4,300 feet a.s.l., and along the eastern edge of the Porcupine Hills. Till and lacustrine sediments have been largely dissected or reworked during the postglacial.

The earlier glaciation reached a minimum elevation of 5,700 feet a.s.l., and till deposited by this ice sheet is a westerly extension of the Basal till, reported by Horberg (1952a) to have terminated near Lethbridge, Alberta. Radiocarbon dates reported by Stalker (in Dyck, Fyles and Blake, 1965) indicate that this advance predated the Classical Wisconsin. Till deposited during the more recent advance is found to 4,820 feet a.s.l., and is correlated with the Lower till mapped by Horberg (1952a) to the southeast of the study area. No absolute age has been determined for this advance, although Stalker reported an age of 9,260±260 years B.P. (Dyck, Fyles and Blake, 1965) for postglacial mollusca near Stavely, Alberta.

The tills can be differentiated on the basis of results of field and laboratory analyses. These included analysis of the pebble orientations, dry colour, grain size distributions, carbonate contents, pebble lithologies, and heavy mineral contents of till samples.

The initial ground moraine surface of the more recent till has been subsequently modified by the combined effects of fluvial and slope erosion. Prior to the incision of the streams into deposits of till and lacustrine sediments, a series of laterally heterogeneous silts were deposited in the valleys. A description of these silts parallels that given by Horberg (1952a) for the Lenzie silts. Erosional terraces along Trout, Lyndon and Cripple Creeks may be related to the levels of proglacial lakes subsequently trapped between the Porcupine Hills and the receding ice sheet. Colluviation has been the major factor in slope reduction since the retreat of the ice sheets from the study area.

Location: ACU, UARC, ID#1704
ACU, Mic., QE 697. D38 1971
AEPAA, 551.314 D33
Areas: Map areas - 82 G, 82 H, 82 I, 82 J
Borden areas - DP, EP
Topics: Glacial chronology, Molluscs, Quaternary stratigraphy, Till - heavy minerals, Till - physical properties

Ferguson, A.J.

1978 Late Quaternary Geology of the Upper Elk Valley, British Columbia. Unpublished Masters thesis, Department of Geology, University of Calgary, Calgary, Alberta. (118 pp.)

Surficial deposits in the upper Elk Valley, B.C. were examined in order to determine (1) the nature and distribution of Quaternary sediments, and (2) Late Quaternary glacial and climatic history of the region. Information on Late Quaternary history was obtained by means of tephra analysis, radiocarbon dating, palynological studies, and a stratigraphic study of the deposits.

Surficial deposits, mapped at a scale of 1:50,000, consist mainly of tills and associated ice-contact sediments, the latter including lake sediments deposited in ice-dammed Glacial Lake Elk. Overlying these deposits are Holocene and modern fluvial and fan deposits, bog deposits, and mass wasting debris.

Tephra was identified as to source by determination of refractive indices of glass shards and, more definitively, by microprobe analysis of the magnetite fraction. Tephra collected from alluvial deposits and bogs was identified as Mazama (6600 B.P.). Tephra collected from pedogenic soils horizons was found to be intermixed with silt and could not be accurately identified. One of the mixed samples may represent a pre-Mazama tephra of unknown origin.

A 4.2 m core from a peat bog contained Mazama tephra, beaver-chewed wood radiocarbon dated at 10125±285 years B.P., and 5 recognized pollen zones: birch-sagebrush tundra (I), spruce-fir (II), pine (III), pine-Douglas fir (IV), and pine-spruce-fir (V). Zone I represents time after deglaciation but before 10125 B.P. Two subzones, designated IIIa and Va, suggest cool, moist climates. These subzones are tentatively correlated with minor Early Holocene and Late Holocene glacial advances. Zone IV and most of Zone III represent relatively warm, dry climates associated with the Altithermal.

Till stratigraphy indicates at least two major glacial advances in the valley. Ice of the older advance, which extended south of the study area, attained elevations above 1935 m (6350 ft). It is correlated with the Big Rock Stade in Alberta. The younger and less extensive advance is correlated with the Canmore Stade in Alberta. There is evidence for two minor glacial advances. One, which extended to the upper Elk Lakes and produced rock glaciers in other cirques, is correlated with Early Holocene advances in Alberta. The other, which resulted in fresh cirque moraines still largely unvegetated, is correlated with the Cavell Advance in Alberta (about 100-200 years B.P.).

A time/depth analysis of bog stratigraphy, utilizing Mazama tephra and dated organic matter, suggests that the southern section of upper Elk Valley was deglaciated by 12000 to 13000 years B.P., the central section by 11000 to 12000 years B.P., and Elk Pass by 8400 years B.P.

Location : ACU, UARC, ID#1866
ACU, Mic., QE 697. F45 1978
Areas : Map areas - 82 J, British Columbia - Elk Valley
Borden areas - EP, region as above
Topics : Glacial chronology, Neoglaciation, Plant macrofossils - wood, Pollen analysis, Tephra - Mazama, Tephra - preMazama

Hawes, R.J.

1977 The Glacial Geomorphology of the Kananaskis Valley, Rocky Mountain Front Ranges, Southern Alberta. Unpublished Masters thesis, Department of Geography, University of Calgary, Calgary, Alberta. (204 pp.)

The Kananaskis Valley is a tributary valley to the south of the arterial Bow Valley at the eastern limit of the Front Ranges of the Rocky Mountains, some 80 km west of Calgary. Present-day glaciers within the study area flow both into the Kananaskis Valley and also across the Continental Divide into the Elk Valley. Surficial deposits and erosional landforms within a 2000 square kilometer area north and east of the Continental Divide indicate that there were at least eight glacial episodes each smaller than the previous one, within the valley, and also at least three minor Holocene glacial events. In addition to aerial photograph interpretation and mapping, identification of the glacial episodes is aided by till fabric analyses and laboratory analysis, comprising lithological, grain-size and carbonate analysis. The glacial episodes are correlated with those described by Stalker (1973) in the northern part of the study area, by Rutter (1972) in the Bow Valley, and by Tharin (1960) in the Calgary area.

The oldest "highest glaciation" is identified only by scattered erosional landforms, and the origin of the glacier occupying the Kananaskis Valley at this time is unknown. It is correlated with Glacier I of Stalker.

During the "Rocky Creek Advance", the northward exit of the Kananaskis glacier from this valley was blocked by Bow Valley ice occupying Marmot and Pigeon Mountain glacial diffluence cols (Walker, 1971): Bow Valley ice filled the Lower Kananaskis Valley. Till veneers containing Gog Group erratics from the Mount Eisenhower area of the Bow Valley and trimlines at high elevations are the main evidence for this glaciation. It is correlated with Glacier II of Stalker, the Bow Valley Advance of Rutter, and the Spy Hill Advance of Tharin. This is the last occasion when Kananaskis ice could have moved south over Elk Pass across the Continental Divide.

Similar but more widespread evidence is used to delimit the third "Mount Wintour Episode". At this time the Kananaskis glacier was able to advance at least to the Barrier Lake area; the Pigeon Mountain Col was still occupied by Bow Valley ice. This advance is correlated with Glacier III of Stalker and the Morley Advance of Tharin; no corresponding advance was recognized by Rutter in the Bow Valley.

The terminus of the Kananaskis glacier during the following "Limestone Mountain Episode" lay beyond the limit of the study area at Barrier Lake. This event is recorded by well-marked lateral moraines and ice contact glaciofluvial deposits. Standstill positions during the retreat of this glacier at Marmot and Galatea Creeks have been identified from meltwater channels and associated glaciofluvial deposits. This is correlated with Glacier IV of Stalker, and the Canmore Advance of Rutter.

The two youngest advances of the Kananaskis glaciers, the "Power Plant Episode" and the "Boulton Creek Episode", advanced no further than the north and south ends of Lower Kananaskis Lakes respectively. Evidence includes a terminal moraine for the older, and a large glaciofluvial complex for the younger. No new radiometric data is introduced, but archaeological evidence (Aresco Ltd., 1977) from the Boulton Creek area of Lower Kananaskis Lake shows the area to have been unglaciated by 8000 years BP.

Location : ACU, UARC, ID#1759
ACU, Mic., GB 588.15 H37 1977
Areas : Map areas - 82 J, 82 O
Borden areas - EP
Topics : Glacial chronology, Till - lithology

Jackson, Jr., L.E.

1977 Quaternary Stratigraphy and Terrain Inventory of the Alberta Portion of the Kananaskis Lakes 1:250,000 sheet (82-J). Unpublished Ph.D. dissertation, Department of Geology, University of Calgary, Calgary, Alberta. (480 pp.)

The oldest glaciation recognized in the study area, the Porcupine Hills glaciation, is named for Rocky Mountain and Laurentide glacial erratics and scattered patches of till above 1400 m altitude on the Porcupine Hills and ridges to the west. The next glaciation is marked by a Rocky Mountain till, the Maycroft, and a Laurentide till, the Maunsell. The glaciation is referred to as the Maycroft-Maunsell Glaciation. The Maycroft Till is seen only on high divides and in buried valleys north of the Highwood River and above 1370 m and south of Chain Lakes reservoir south of the Highwood River. The Maunsell till is primarily confined to the valleys of Willow and South Willow creeks. The Maycroft and Maunsell Tills are overlain by the Chain Lakes Clays and Silts -- glaciolacustrine sediments laid down in Glacial Lake Westrup.

The last glaciation is called the Erratics Train Glaciation. Three stades are recognized. The oldest, the Big Rock Stade, involved the coalescence of Rocky Mountain and Laurentide ice. The two subsequent stades, the Canmore Advance and the Eisenhower Junction Advance involved an alpine advance with no corresponding Laurentide readvance in the study area.

Physical properties and clay mineralogy of the glacial deposits of the study area range with bedrock provenance. Tills and glaciolacustrine sediments of the front ranges are low in plasticity. Tills are stony loams and sandy loams. Tills of the easternmost foothills and prairies are slightly stony loams to clayey or silty loams of intermediate plasticity and of low to moderate swell potential. Glaciolacustrine sediments range widely in texture and have a high swell potential. Tills of the foothills are transitional between those of the easternmost foothills and prairies and the front ranges in their physical properties.

Location : ACU, UARC, ID#1861
Areas : Map areas - 82 J
Borden areas - EP
Topics : Erratics Train, Glacial chronology, Glacial lake sequences, Quaternary stratigraphy, Till - lithology

Karlstrom, E.T.

1981 Late Cenozoic Soils of the Glacier and Waterton Parks Area, Northwestern Montana and Southwestern Alberta and their Paleoclimatic Implications. Unpublished Ph.D. dissertation, Department of Geography, University of Calgary, Calgary, Alberta. (358 pp.)

Soils and associated glacial deposits in the Glacier-Waterton Parks area represent at least seven major glacial and interglacial events of the Pleistocene and probably late Pliocene. Tills deposited by mountain glaciers in the Waterton valley and by mountain and corresponding Laurentide glaciers in the Belly River and Saint Mary River valleys are assigned to Illinoian, Early Wisconsin and Late Wisconsin ages on the basis of geomorphic relations, soils evidence and new radiocarbon data. In addition between one and four "pre-Illinoian" mountain tills (collectively named "Kennedy drift" by Alden (1924)), separated by truncated paleosols, are preserved on ten Flaxville (Pliocene) erosion surface remnants which form the interfluve divides along the eastern border of Glacier and Waterton Parks.

The degree of profile development of Glacier-Waterton Parks soils corresponds with their relative ages. Post-Late Wisconsin soils are weakly developed Inceptisols (Brunisols) in the mountains and Mollisols (Chernozems) in the plains while post-Early Wisconsin soils are moderately developed Alfisols (Luvisols) in the mountains and Mollisols (Chernozems) in the plains and post-Illinoian soils in the mountains are strongly developed Alfisols (Luvisols). The most complete and best expressed sequence of very strongly developed "pre-Illinoian" soils (including MB Soils 1 through 4) is preserved on Mokowan Butte. MB soils 4 and 3 and correlative soils on other Flaxville ridges are intensely weathered Paleudults and Paleudolls which have leached, reddish Bt horizons which are two to five meters thick and contain 26 to 36% clay, 1.4 to 2.0% free iron, and halloysite-illite and chlorite-vermiculite and/or chlorite-montmorillonite mixed layer clays in addition to inherited illite, chlorite and kaolinite. The microfabric of Bt horizons is often plugged with illuviated clay. Because these soils are genetically similar to Mediterranean soils and Ultisols, it is inferred that they represent significantly warmer and moister conditions than the present climate and extremely long periods (between 200,000 and a million years) of soils formation. MB Soils 2 and 1 (a Paleustalf and Eutroboralf, respectively) are considerably thinner than MB Soils 4 and 3. Genetic soil properties suggest that MB Soil 2 also represents an environment considerably warmer than the present.

On the basis of the stratigraphic and genetic implications of Glacier-Waterton Park soils, MB Tills 1, 2, 3 and 4 are provisionally correlated with worldwide glaciations dated at 2.8 to 2.4, 2.7 to 2.3, 2.4 to 2.2 and 1.2 to 0.7 million years, respectively, while MB Soils 1, 2, 3 and 4 are tentatively correlated with predominantly interglacial conditions dated between 2.8 and 2.4, 2.7 and 2.3, 2.2 and 1.2 and 0.7 and 0.2 million years respectively. Post-Illinoian, post-Early Wisconsin, and post-Late Wisconsin soils, then, are tentatively correlated with the Sangamon, Port Talbot, and Holocene (O^{18} Stages 5, 3, and 1) interglacials dated at about 125,000 to 82,000 BP, 50,000 to 40,000 BP and 10,000 BP to present, respectively. The markedly warmer soils forming conditions implied by genetic properties of MB Soils 2, 3 and 4 may be partly accounted for by dramatic regional uplift (by 500 to 1500 meters) during the late Pliocene and Pleistocene, as postulated by Alden (1924), Cook (1966) and others. If so, MB Soils 1, 2, 3 and 4 would have developed at significantly lower elevations under commensurately higher temperatures than the present landscapes.

Location : ACU, UARC, ID#3438
ACU, Mic., QE 691. K37 1981
Areas : Map areas - 82 G, 82 H, Montana - Glacier National Park
Borden areas - DP, region as above
Topics : Glacial chronology, Palaeosols, Soil - chemical properties, Soil - mineralogy, Soil - pedogenesis

Kingston, M.S.

1982 An Evaluation of the Recommended Methods for Paleosol Investigations: A Case Study of a Holocene Paleosol, Calgary, Alberta. Unpublished Masters thesis, Department of Geography, University of Western Ontario, London, Ontario. (166 pp.)

This study evaluates the usefulness of a range of techniques recommended for paleosol investigations by means of a case study of a buried paleosol. The paleosol occurs in a 50 m long section of a stream bank of Fish Creek within the city limits of Calgary. An analysis of selected physical and chemical characteristics of the stratigraphic units revealed units of fine-textured, calcareous deposits. A layer of volcanic tephra was identified as Mazama ash by electron microprobe analysis of glass-encased magnetite grains. A date of 13,900 ± 700 years B.P. obtained on carbonates from the A horizon of the paleosol was concluded to be too old, as similar paleosols had been dated at 8,400 years B.P. The presence of Mazama ash overlying the paleosol indicated that burial occurred prior to 6,600 years B.P. Bulk samples were analyzed using a range of routine and special analytic techniques. Decalcification and organic matter accumulation were found to be the major processes influencing the paleosol prior to burial. The major processes during the post-burial period were recalcification and organic matter degradation. In situ weathering and recrystallization of sesquioxides and physical weathering to form clay-sized particles were processes of lesser importance. The determination of colour, carbonate content and organic matter content proved to be the most useful techniques for investigating the paleosol. The level of sampling intensity did not significantly affect the usefulness of the techniques. It was, however, useful to investigate the paleosol at the micro-scale. Micromorphology revealed a limited reorganization of the plasmic fabric and post-burial changes in the S-matrix fabric. The validity of using a broad scale of investigative techniques was therefore confirmed. The study indicates the usefulness of the techniques is conditioned by the local site conditions, the type of soil properties, and the purposes of the investigation.

Location : IC
Areas : Map areas - 82 J
Borden areas - EP
Topics : Soil - chemical properties, Soil - micromorphology, Soil pedogenesis, Soil - physical properties, Tephra - Mazama

Love, M.A.

1977 Late Wisconsinan Ice Movements and Deglaciation in the N.E. Porcupine Hills Area, Alberta. Unpublished Masters thesis, Department of Geography, University of Calgary, Calgary, Alberta. (133 pp.)

The study of a 1476 km^2 area located in the N.E. Porcupine Hills of Southwest Alberta has provided most evidence for the movement and retreat of two Late Wisconsinan ice masses; the hybrid Marguerite (western) and Lochend (eastern) ice sheets. Although most evidence is given for the last glaciation, information is cited which relates to the earlier eastern Labuman and Maunsell advances of glacial Events Three and Two age respectively. No deposits from earlier western incursions of ice have been found, though it is known from mapping in an adjacent area to the west (Waters, 1975) that such advances entered that area.

Evidence relating to the Labuma advance consists of the high level igneous and metamorphic erratics. Maunsell deposits are much more coherent and may be found in a small zone in the southwest portion of the area. Hybrid Marguerite till displays mixed characteristics, though on the basis of pebble lithology it can easily be differentiated from the eastern tills in the area. The hybrid Marguerite glacier undoubtedly assimilated foreign eastern material as it flowed southwards over areas previously traversed by Laurentide advances. It was deflected southwards by the Lochend ice sheet which lay to the east of the mountains. Laboratory analyses confirm the eastern origin of the Lochend till. Both ice masses are considered to have been coeval.

During deglaciation, which was effected by both ice stagnation and orderly retreat, a large proglacial lake (Lake Eden) was impounded in the area for which two still-stands have been recognized. An efficient system of meltwater channels formed at this time as the lake was drained. From ^{14}C dates given by various researchers (e.g. Harris and Boydell, 1972) the area most probably became free of ice during the very early Holocene.

Location : ACU, UARC, ID#1760

ACU, Mic., GB 588.15 L67 1977
Areas : Map areas - 82 I, 82 J
Borden areas - EP
Topics : Glacial chronology, Glacial lake sequences, Till - lithology

Mandryk, G.B.
1986 Pleistocene Valley Glacier Sedimentology and Stratigraphy in the Banff-Canmore Area of Alberta, Canada. Unpublished Masters thesis, Department of Geology, University of Alberta, Edmonton, Alberta. (290 pp.)

This study was conducted in the glaciated Bow River valley, located in the Canadian Rocky Mountains. Unconsolidated valley-fill sediments consisting of diamicton and sorted sediments were examined in the Banff and Canmore region of Alberta. The study was undertaken in this particular area so that recent advances in glacial sedimentology, made since some of the deposits were previously studied, could be applied and thus result in a more comprehensive understanding of the region's glacial history.

Seven facies were recognized. Facies 1 consists of a diamicton with numerous sorted sediment filled lenses; many of the lenses are inclined. Facies 1 is interpreted to be basal melt-out till. Facies 2 consists of a diamicton that has numerous elongated, thin gravel layers. Facies 2 is interpreted to be lodgement till. Facies 3 consists of a massive diamicton with very few, sorted sediment-filled lenses. Facies 3 is interpreted to be lodgement till. Facies 4 consists of a diamicton with numerous, generally horizontal lenses filled with sorted sediment. Facies 4 is interpreted to be basal melt-out till. Facies 5 consists of mainly an interfingered, interbedded sequence of poorly sorted gravels, diamicton lenses and blocks. Some poorly sorted gravels are also present. Facies 5 is interpreted to be proglacially deposited glacial mudflow complexes, dissected till plains, and glacial outwash channel-fill deposits. Facies 6 consists of mainly horizontal, interbedded, interfingering lens-shaped gravel horizons. Facies 6 is interpreted to be braided glacial outwash deposits with a minor amount of alluvial fan deposits. Facies 7 consists of mainly interbedded gravel and sand layers. Facies 7 is interpreted to be ice proximal, proglacial outwash sediments.

Three major, glacially related sedimentation events are recognized in the Banff-Canmore area. The first major event is marked by the formation of a sandur in front of a retreating valley glacier. The second major event is defined by the advance of a valley glacier which also deposited a thick basal till. The third major event began with a glacial advance just into the study area, this advance deposited a proglacial mudflow complex. The glacier then retreated slightly and then readvanced completely through the study area. This final glacial advance deposited basal till. The final glaciation was 2-10 times shorter than the event 2 glacial advance. The final deglaciation of the Banff and Canmore area featured a debris-free glacier occupying the Bow River valley, gradually melting away.

Location : AEU, SPCOLL, Thesis 86F-142
Areas : Map areas - 82 O
Borden areas - EP
Topics : Facies studies, Glacial chronology

Pennock, D.J.

1985 Soil Landscape Evolution in the Highwood River Basin, Southern Alberta. Unpublished Ph.D. dissertation, Department of Geography, Queen's University, Kingston, Ontario.

The geomorphological and pedological evolution of a series of landsurfaces in the Highwood River Basin, Southern Alberta was investigated. Three landscape zones were examined: a terrace landscape associated with the Highwood River; an upland landscape underlain by glaciogenic sediments; and a transitional zone between the two zones.

Soil stratigraphical, sedimentological, and pedological methods were used to develop a chronology of events for the terrace and transitional landscapes. Four terrace levels were determined to have resulted from incision of the Highwood River: a 31 m above stream level (ASL) terrace (undated); a 25 m terrace (abandoned by 6000-7000 years B.P.); a 14 m terrace (abandoned by 600-700 years B.P.); and a 5 m level (abandoned by 100-200 years B.P.). Eolian deposits with several paleosols cover a pre-Mazama (6600 years B.P.) paleosol on the upper two terraces.

Sites in the transitional zone exhibited evidence of stable pedogenesis on level sites, and colluviation and pedogenesis on sloping sites during the pre-Mazama period. Burial of these soils and surfaces by eolian deposits occurred in the post-Mazama period.

The evolution of the upland was assessed using a grid of boreholes in a representative area. The results indicate that two colluvial episodes occurred in the pre-Mazama period. A Solonetzic-Chernozemic soil paleo catena formed in the colluvial deposits of the last episode. The paleo catena was buried by eolian deposits in the post-Mazama period.

Several lines of evidence indicate that moister conditions occurred in the pre-Mazama period. Two possible explanations for moister conditions, climatic change and higher groundwater conditions, are examined.

Location : DAI
Areas : Map areas - 82 I, 82 J
Borden areas - EP
Topics : Geomorphology - terraces, Palaeosols, Soil - pedogenesis, Tephra - Mazama

Stene, L.P.

1976 Holocene and Present Alluvial Investigations, Porcupine Hills, Southwestern Alberta. Unpublished Ph.D. dissertation, Department of Geography, University of Western Ontario, London, Ontario.

This study investigates present-day and Holocene fluvial processes and sediments of selected valleys of the Porcupine Hills of southwestern Alberta. The original intent of the study was to establish a regional Holocene alluvial chronology and to interpret the environmental conditions that led to alluviation and terrace development. Stratigraphic complexities, lack of absolute dates, and paucity of interpretable environmental data did not permit successful completion of the original objectives. With this realization, further study concentrated on the alluviums and their possible mode of origin. The study of present-day fluvial processes and sediments permitted more critical assessment of the paleoflows responsible for Holocene alluvial events.

Evidence is presented to show that late Wisconsin Laurentide ice reached the lower eastern and southern slopes of the Porcupine Hills, a view contrary to current literature on the subject. A relative alluvial chronology was established for the lower Trout Creek Valley. Based mainly upon terrace height considerations, the chronology demonstrated that seven episodes of alluviation and terracing occurred during the Holocene. The presence of Mazama tephra and radiocarbon dates from the lower terraces provided a check on the validity of the relative alluvial chronology.

After establishing the hydrologic characteristics of Porcupine Hills streams a study site located on Trout Creek was monitored for three years to provide insights into present-day alluvial processes. It was shown that below-bankfull discharges are capable of channel modification along a gravel bed stream. Stream bed particle entrainment formulae were tested at the study site and most were found wanting. Testing of such formulae was necessary for evaluation of their usefulness in estimating competence of paleoflows responsible for the ubiquitous terrace gravels along Trout Creek. In addition, tracer rock experiments at the Trout Creek site demonstrated relationships between distance of transport and bed particle diameters.

As there is little certainty that the Trout Creek site results were typical of most study area stream reaches some of the evaluations carried out at the Trout Creek site were extended to 85 other stream reaches. Again, bed particle entrainment formulae utilizing carefully estimated bankfull flow measures proved inadequate in predicting particle motion. The later application of certain of these formulae to Trout Creek terrace gravels in order to estimate paleoflow competence demonstrated weaknesses in reconstructing paleohydraulics.

By means of regression analyses the downstream relationships between particle parameters and certain hydraulic characteristics were examined for six study basins. Analysis of downstream changed within the Trout Creek terrace gravels showed that their characteristics departed little from those of the adjoining present channel. It is suggested that the Holocene streams responsible for gravel deposition differed little in character from present-day Trout Creek.

The origin of the thick, fine-grained terrace alluviums is believed due to overbank deposition and evidence is presented to support such an interpretation. Much of the fine-grained alluvium was likely the result of erosion of headwater regions affected by forest fire activity. Possible, but uncertain, causes of stream degradation and terrace formation are also discussed in the concluding chapter.

Location : DAI
Areas : Map areas - 82 G, 82 H, 82 J
Borden areas - DP, EP
Topics : Geomorphology - terraces, Glacial chronology, Sedimentology

Vernon, P.D.

1962 Tills of the Lethbridge Area, Alberta; Their Stratigraphy, Fabric and Composition. Unpublished Masters thesis, Carleton University, Ottawa, Ontario. (107 pp.)

Six tills are recognized in the Lethbridge area and grouped into two formations. The lower formation is named the "Expanse Formation" and the upper "Whoop Up Formation".

In each till there is a distinct alignment of the long axes of stones, i.e. a "Till fabric", which can be used in correlation. Preglacial topography had a strong influence on the flow of ice, and this influence can be recognized in the till fabric patterns.

The stone-lithology, and the mechanical composition, carbonate-ratios and clay mineralogy of the till matrix are examined. The composition of both the stones and the matrix varies with the direction from which the ice entered the area. The stone lithology of the tills is related to the composition of the preglacial gravel over which the ice advanced. The composition of the matrix reflects the nature of the underlying bedrock.

Location : ILL, Carleton University Library, Ottawa
Areas : Map areas - 82 H
Borden areas - DP
Topics : Glacial chronology, Quaternary stratigraphy

Wagner, W.P.
1966 Correlation of Rocky Mountain and Laurentide Glacial Chronologies in Southwestern Alberta, Canada. Unpublished Ph.D. dissertation, University of Michigan, Ann Arbor, Michigan. (141 pp.)

The purpose of this study is to determine and correlate the chronologies of Rocky Mountain and Laurentide glacial deposits which overlap in southwestern Alberta, Canada. Surficial deposits were mapped in the mountains, foothills, and plains north of the International Boundary and west of Lethbridge. In addition, older, buried deposits were examined in cliff-bank exposures along Oldman, Castle, Crowsnest, and Belly Rivers between the mountains and the plains in the vicinity of Lethbridge.

The oldest glacial deposit in the region is Mountain till M I on which is developed a very thick and mature paleosol, the Cloudy Ridge soil. Till M I is correlated with Richmond's (1965) Sacagawea Ridge glaciation of Illinoian (?) age. No equivalent Laurentide drift is recognized. The next youngest glacial deposit is Laurentide "basal till" of Altonian and Bull Lake age. The basal till is distinguished from the next youngest Laurentide till, the "lower till", by stratigraphically intervening and exotic "bedrock masses", extensive layers of Cretaceous strata whose mode of emplacement between tills is uncertain. Although the "bedrock masses" are assumed to separate the basal and lower Laurentide tills, a hypothesis is offered which, if correct, invalidates both the basal till as a separate drift and previous interpretations of a radiocarbon date at Kipp, just west of Lethbridge. Mountain drift equivalent to the basal till is not recognized in the area.

The surface drifts, including parts of the Laurentide lower and upper tills, and part of Mountain till M II, are Woodfordian, mid- and late Pinedale in age. Early Pinedale (Woodfordian?) ice activities include the maximum advance of Mountain piedmont glaciers and deposition of till M II as much as 50 miles from the mountains, and subsequent Laurentide ice advance and deposition of the lower till as far west as the foothills. During mid-Pinedale (Woodfordian) time Laurentide terminal and Mountain recessional end moraines (lower till and Mountain till M II) were constructed contemporaneously by Laurentide and Mountain ice masses in contact in the foothills. In late Pinedale (Woodfordian) time recessional Mountain moraines (till M II) a few miles above the mountain front and the Laurentide Lethbridge moraine (upper till) were deposited.

Deglaciation at least by 13,000 years ago was accompanied by extensive proglacial lakes, three of which are newly named here. New interpretations of Horberg's (1952) "Lenzie silt" warrant a revision of the history and areal relations of Lake Lethbridge. In many places, especially near the present day streams, alluvial deposits overlie lacustrine sediments. Two ages of alluvium are differentiated on the basis of color and fossil content, chiefly mollusks and vertebrates. Mount Mazama ash near the top of the older alluvium indicates that the younger alluvium is less than about 6,600 years.

The latest glacial event is recorded by Mountain cirque moraines which have the characteristics of Temple Lake moraines recognized elsewhere.

The interpretations in this paper of three Laurentide tills which are all Wisconsin in age, and two Mountain tills which are late Wisconsin and pre-Wisconsin (Illinoian?) are in contrast to Stalker's (1963) Laurentide chronology and Horberg's (1954) Mountain chronology. The stratigraphic differences which Stalker interprets as due to multiple glaciation are here explained by a single glaciation hypothesis. This hypothesis involves varying degrees of glacier ice and proglacial lake water interaction during active-ice recession. A similar hypothesis involves glacier ice and proglacial lake water interaction during stagnant-ice recession; differences in the internal composition and topographic expression of moraines are explained by variations of Hoppe's (1952) concept of ice-pressed drift.

Location : AEPAA, 551.314 W125
Areas : Map areas - 82 G, 82 H
Borden areas - DP
Topics : Bedrock blocks, Glacial chronology, Glacial lake sequences, Palaeosols, Tephra - Mazama

Waters, P.L.
1979 Postglacial Paleoenvironments of Southern Alberta. Unpublished Masters thesis, Department of Geology, University of Alberta, Edmonton, Alberta. (107 pp.)

In a widespread area of southwestern Alberta, paleosols have been recognized in postglacial sediments. These deposits consist of alluvial, colluvial and lacustrine material. In many cases, a layer of tephra occurs either directly in contact with, or a few centimetres above the paleosols.

Examination of eight sections reveals that, at seven localities, primary Mazama ash overlies the paleosols. At the remaining locality, the ash is Mazama, but it has been reworked to some extent. This suggests that the paleosols are penecontemporaneous profiles. The paleosols have been identified as either of the Chernozemic Order or the Regosolic Order. Phytoliths contained in the Ah horizons indicate a vegetative suite dominated by short grasses.

Interpretation of the data suggests these soils developed under a warmer and drier climate than the present. This development indicates a period of non-deposition, when a stable landscape existed over southern Alberta. This period of climatic amelioration appears to represent the Altithermal Interval in Western Canada. Yet, the immature nature of the soils supports the idea of the period being short-lived, ending by the time of Mazama ash deposition (6600 years B.P.). Sedimentation resumed and appears continuous with no other major periods of soil development until the present day profile.

Location : AEU, SPCOLL, Thesis 79F-194
Areas : Map areas - 82 G, 82 H, 82 I, 82 J, 82 O, 82 P, 83 A, 83 B, 83 H
Borden areas - DP, EP, FP
Topics : Opal phytoliths, Palaeosols, Soil - pedogenesis, Tephra - Mazama

Waters, R.R.
1975 The Glacial Geomorphology of the Pekisko Creek-Happy Valley Area, Alberta. Unpublished Masters thesis, Department of Geography, University of Calgary, Calgary, Alberta. (191 pp.)

The surficial deposits of a 1200 square kilometre area 65 km (40 mi) southwest of Calgary, Alberta, indicate that the region has been subject to extensive multiple glaciations on at least three separate occasions during the Pleistocene epoch. The Albertan and Labuma tills represent the mountain and laurentide shield ice masses which invaded the area during the earliest recorded glacial event. During the next recorded event, the evidence found indicates that four distinct western glaciers (the Cartwright, Pekisko, Stimson Creek, and Timber Creek glaciers), invaded parts of the foothills before the Maunsell ice sheet reached the Willow Creek area. During the most recent recorded glaciation, the Marguerite ice mass, originating probably from the Bow river valley, invaded a major portion of Happy Valley and the north Porcupine Hills. An eastern ice sheet (the Buffalo Lake ice sheet), was probably present several kilometers east of the study are at the same approximate time. ...

The Marguerite ice mass [(a composite glacier?) figure 38, pp. 138], probably extended at least as far south as the Willow Creek area. This ice mass probably originated in the Bow and Red Deer River Valleys, and seems too have been deflected southwards by the Buffalo Lake ice sheet.

The latter ice sheet did not penetrate the Willow Creek valley, but it extended a short distance up the Oldman River Valley. The morainal patterns found around Frank Lake and Stavely may be relict crevasse patterns formed when the two ice masses come into collision. The final deglaciation of the region took place by both orderly retreat and widescale stagnation. Characteristic landform assemblages mark the areas where each deglacial process pre-dominated.

Proglacial lakes were imponded by the ice masses during each glacial event, but only the event two and three lakes can be mapped in detail. No organic material was found, thus no new radiometric data is offered. Radiocarbon dates from farther north (Stalker, 1968) indicate that deglaciation had begun by 11,00 B.P. (radiocarbon), and L. Jackson (personal communication, 1975) has found organic material northwest of the study area that tends to confirm this observation.

Differentiation of some of the tills found was possible only by using more than one field and laboratory test. The Labuma and Marguerite tills are almost lithologically identical, however a small consistent difference can be found in their heavy mineral suites.

The conclusions of Douglas (1958) and Alley (1972, 1973) concerning the genesis and distribution of surficial deposits in the Highwood and Oldman River Valleys is confirmed. The conclusion of Alley (1972, 1973), that three glacial events are recorded for this region, is also upheld.

Abstract : Abbreviated from the Author's Abstract
Location : ACU, UARC, ID#1755
ACU, Mic., GB 588.15 W38 1975
Areas : Map areas - 82 I, 82 J
Borden areas - EP
Topics : Glacial chronology, Glacial lake sequences, Till - heavy minerals, Till - lithology

b. Central Western Corridor

Bowyer, A.

1978 The Sunwapta Section: Composition and Development of a Complex Stratigraphic Section from Sunwapta Pass, Jasper National Park. Unpublished Masters thesis, Department of Geography, University of Western Ontario, London, Ontario. (164 pp.)

The study examines the composition and development of a complex stratigraphic section from the Sunwapta Pass, Jasper National Park. An analysis of the chemical and physical characteristics of the various stratigraphic components revealed the presence of a sequence of deposits including three volcanic ash layers interspersed with deposits of colluvial/alluvial and aeolian origin. On the basis of an electron microprobe analysis of glass shards from each of the three ashes, Bridge River, St. Helens Y and Mazama ashes were identified. The identifications were corroborated in part by a radiocarbon date of 6170±100 B.P. obtained on charcoal fragments from a layer overlying Mazama ash. Pedogenic degradation of the volcanic ashes resulted in the production of amorphous iron and aluminium silicates. The clay mineralogy of the section, dominated by illite, chlorite, vermiculite and intergrade material, showed development of an expanding clay mineral specifically associated with the volcanic ash. Laboratory simulation of the ash degradation under the influence of a chelating agent (EDTA) showed that the ash degraded and released substantial amounts of iron and aluminium which may then be involved in clay mineral formation. The presence in the section of palaeosols formed in association with the ash and aeolian deposits together with various layers containing charcoal fragments clearly attests to a complex history at the site, including episodic phases of alluviation/colluviation and aeolian deposition including volcanic as from at least three separate eruptions. Pedogenesis has occurred in situ with interruption by forest fires. In consequence, the section is important in providing a basis for palaeoenvironmental reconstruction in the Sunwapta Valley during the Holocene.

Location : IC
Areas : Map areas - 83 C
Borden areas - FQ
Topics : Charcoal - fire history, Soil - chemical properties, Soil - pedogenesis, Soil - physical properties, Tephra - Bridge River, Tephra - Mazama, Tephra - St. Helens

Boydell, A.N.

1970 Relationship of Late-Wisconsin Rocky Mountain and Laurentide Ice in the Vicinity of Sundre, Alberta. Unpublished Masters thesis, Department of Geography, University of Calgary, Calgary, Alberta. (140 pp.)

This thesis is a study of the glacial geomorphology of a zone along the Red Deer river in the vicinity of Sundre, Alberta, where evidence can be found for the former presence of Rocky Mountain and Laurentide ice. Only one major advance of each ice mass can be established. Associated with the Laurentide advance and subsequent deglaciation are lake deposits and a series of spillways. Glacial deposits occur on valley sides and in valley bottoms, and post-glacial stream development has cut down into these deposits.

All accessible sections in road cuts, gravel pits and along streams were examined and described. Fabric studies were carried out in the field and samples collected for the laboratory program which consisted of mechanical, lithological and heavy mineral analyses.

From these analyses, maps were drawn to illustrate and supplement the following sequence of events.

The onset of the Wisconsinan in the study area was marked by an advance of the Rocky Mountain ice which spread over the lower land in the Sundre area, probably as a piedmont lobe. As this Rocky Mountain ice retreated, the Laurentide ice was approaching from the northeast, the meltwater from both ice masses forming a lake in the Red Deer valley. As far as can be ascertained, the two ice masses did not meet in the study area. The Laurentide ice advanced, at its maximum, some twenty miles above Sundre, causing the lake area to contract and forming at least one small spillway.

It is thought that the Laurentide advance also brought the Erratics Train into the area. Characteristic Arkosic erratics were found in situ in the Laurentide till and it is suggested that they were transported by the Laurentide ice.

During the Laurentide deglaciation,the level of Lake Sundre dropped, this being controlled by successively lower spillways along its southern margin. When the post-glacial Red Deer river became established, it deposited large quantities of gravels as valley fill. The modern river has now cut down some ten feet into these deposits.

Location : ACU, UARC, ID#1698
ACU, Mic., QE 697. B67 1970
Areas : Map areas - 82 O
Borden areas - EP
Topics : Erratics train, Glacial chronology, Glacial lake sequences

Boydell, A.N.
1972 Multiple Glaciation in the Foothills, Rocky Mountain House Area, Alberta. Unpublished Ph.D. dissertation, Department of Geography, University of Calgary, Calgary, Alberta. (127 pp.)

The distribution and stratigraphy of surficial deposits in the Foothills, rocky Mountain House Area, Alberta, reveal evidence of multiple glaciation. Mapping of the deposits was supplemented by dry-auger drilling, till fabric analysis, lithological, heavy mineral and carbonate analyses.

In the absence of suitable radiometric data, stratigraphic and morphologic evidence was used to establish the relative ages of three Rocky Mountain glacial advances: the Hummingbird/Baseline, and the Lamoral and Jackfish Creek. The absence of glacial deposits above 1,660 meters (A.S.L.), and the presence of colluvial mantles and subdued glacial forms, define an area of the Brazeau and Ram Ranges which remained ice-free during the Late-Wisconsin, although it was glaciated in Early Wisconsin times.

Only one Laurentide advance could be documented, depositing the Athabasca/Sylvan Lake tills. This is thought to have been present in the area for the whole of the Late-Wisconsin. The Laurentide ice mass restricted the eastward extent of the Lamoral and Jackfish Creek glaciers and caused them to be deflected to the southeast.

Rocky Mountain and Laurentide ice masses impounded Late-Wisconsin proglacial lakes in the river valleys, and their sediments form both surficial and inter-till units. A major lake, glacial Lake Caroline, occupied the Rocky Mountain House-Caroline area during deglaciation. Rocky Mountain meltwaters were impounded by the Laurentide ice, a kame moraine was formed in the Cow Lake area, and successively lower spillways were cut in the east and southeast. The area was probably ice-free soon after 9,600 years B.P.

Location : ACU, UARC, ID#1715

ACU, Mic., QE 697. B667 1972
AEPAA, 551.314 B692
Areas : Map areas - 83 B
Borden areas - FP
Topics : Glacial chronology, Glacial lake sequences, Till - heavy minerals, Till - lithology

Fox, J.C.
1974 Glacial Geomorphology of the Cataract Brook Valley, Yoho National Park, British Columbia. Unpublished Masters thesis, Department of Geography, University of Alberta, Edmonton, Alberta. (148 pp.)

The study was undertaken to map the surficial deposits and landforms in the Cataract Brook Valley, Yoho National Park, B.C, and to determine the glacial history of the valley. The study area lies just to the west of the Continental Divide, extending south from Kicking Horse Pass.

No stratigraphic sections were found that contain more than one till sheet, and the tills cannot be differentiated by grain size or lithologic characteristics. Therefore reliance was placed on geomorphic criteria and the areal relationships between tills and other glacial deposits and landforms. Field work was conducted to map the surficial deposits and landforms and to determine the relative ages of the tills. Laboratory work was conducted to describe and differentiate the tills.

Four glacial ice advances are recorded. The oldest advance, the earliest recorded in the study area, is indicated by high altitude remnants of lateral moraines and breaks in slope. This advance is tentatively correlated with Rutter's (1972) Eisenhower Junction advance, in the Bow Valley. A second advance, the Early Intermediate advance, is recorded by lower breaks in slope, two recessional moraines, ground moraine and two kame terraces. This advance also extended out of the study area, via the Kicking Horse Pass, to the east. The next advance, the Late Intermediate advance, extended to the central portion of the Cataract Brook Valley. Evidence for this advance includes well preserved end moraine systems, deposited by four bodies of ice, erosional surfaces, fresh cirques and terminal moraines. The most recent advance was limited to the extreme upper portions of the cirques. The evidence for this recent advance includes six fresh, well-preserved terminal moraines and some lateral moraines.

The recent advance is dated from photographic evidence as achieving its maximum extent in the early part of this century. The Late Intermediate advance is probably of Neoglacial age (post-Altithermal - 6500 - 4000 yrs B.P.) and the Early Intermediate and Oldest advances are probably pre-Altithermal in age.

Rock glaciers, block fields and pro-talus ramparts indicate two cold periods between the Late Intermediate and the most recent advance.

Location : AEU, SPCOLL, Thesis 74F-56
Areas : Map areas - 82 N, British Columbia - Yoho National Park
Borden areas - EQ, region as above
Topics : Glacial chronology, Glacial geomorphology, Neoglaciation, Till - lithology

Gambier, A.M.

1984 Glacigenic Streamlined Landforms in the Hinton/Edson Area, Alberta. Unpublished Masters thesis, Department of Geography, University of Alberta, Edmonton, Alberta. (134 pp.)

Drumlins and other flutings are widespread in the Hinton/Edson area. The orientation of these streamlined forms is approximately 40°-220°. This trend follows the Athabasca River valley and presumably parallels the former flow direction of ice close to the valley centre. Ice moulded landforms to the east illustrate deflection of former ice flow, first eastwards and then southwards. This deflection is attributed to confluence of the Laurentide Ice Sheet and Cordilleran piedmont ice when the landforms were formed.

Forestry road cuts have exposed sections through three streamlined landforms in the vicinity of Canyon Creek, ten kilometres northeast of Hinton and these forms have been investigated intensively. Diamicton is the dominant material exposed but numerous stratified layers reveal a complex internal structure. Thrust blocks and overturned folds are well displayed in one fluting, indicating that the sediments of the proximal part of this form have undergone stacking by shearing and overfolding. It is proposed that a transverse feature similar in origin to a Ribbed or Rogen moraine, acted as a nucleus for fluting formation and that the fluting resulted from subsequent lee-side agglomeration of debris-rich ice behind this obstacle. Final till deposition occurred by melt out. The importance of melt out processes to the final preservation of drumlins and flutings in the Hinton/Edson area is evident from observations of two other streamlined forms.

Two-dimensional and three-dimensional fabric patterns illustrate the complexity of fabric orientations within each form and raise questions concerning the role of fabric analyses in the evaluation of genetic processes.

Location : AEU, SPCOLL, Thesis 84-35
Areas : Map areas - 83 F
Borden areas - FQ
Topics : Glacial geomorphology - drumlins, Glacial geomorphology - flutings, Glacial chronology, Ice movement indicators, Till - fabric

Glendinning, G.R.

1974 The Glacial Geomorphology of an Area Near Calgary, Alberta, Between the Bow River and Fish Creek Valleys. Unpublished Masters thesis, Department of Geography, University of Calgary, Calgary, Alberta. (145 pp.)

The surficial deposits of a 1650 square kilometer area near Calgary, Alberta, suggest that at least three distinct ice sheets: the Morley glacier from the Bow Valley, and ice sheet from some valley north of the Bow Valley, and a Laurentide ice sheet, were present at the same time during the Wisconsin time. Identification of the ice sheets is aided by till fabric analysis and laboratory analyses, including lithological, heavy mineral,and carbonate analyses.

The conclusions of three previous workers: Tharin (1960), Morgan (1966), and Seagel (1971) as to the distribution of surficial deposits are examined in an attempt to reconcile the conflicting views. The conclusions of Morgan and Tharin are upheld in the question of the location of the boundary between eastern and mountain tills at the eastern margin of the study area. It is concluded that Seagel did not undertake sufficient lithological and petrological analyses to distinguish eastern and mountain tills, and that he identified two mountain tills instead.

The Spy Hill till, deposited during an earlier advance of ice from the Bow Valley, according to Tharin, can not be positively identified in the areas designated by him. The only evidence of the till is provided by till fabrics in the southern part of the central portion of the study area, and it is believed that the earlier advance did in fact occur, based on these fabrics and on evidence from boreholes provided by Rutter and Wyder (1969).

The boundary between the mountain tills was placed slightly to the west of the position assigned to it by Morgan. It is tentatively suggested that the mountain till occupying the northern part of the central portion of the study area was deposited by the Elkton Creek glacier, with a source area in the Red Deer Valley, based on the work of Boydell (1970) in the Red Deer Valley near Sundre, Alberta. This view conflicts with those of Morgan and Tharin, who suggested that the source of this glacier was the Athabasca Valley.

A sequence of events which led to the creation of a series of progressively lower elevations of glacial Lake Calgary is suggested, and a tentative history of the lake provided. The southern boundary at various stages is delineated, and several meltwater channels not previously identified are suggested as high level outlets of the lake.

No new radiometric data is introduced, but it is tentatively suggested, on the basis of existing data from the Cochrane, Alberta area and elsewhere, that the onset of deglaciation occurred about 12,500 years B.P., and that Glamorgan Channel stage of Lake Calgary occurred about 10,500 years B.P. The study area is thought to have become ice-free soon after 9,500 years B.P.

Location : ACU, UARC, ID#1734
ACU, Mic., GB 588.15 G42 1974
Areas : Map areas - 82 J, 82 O, 82 P
Borden areas - EP
Topics : Glacial chronology, Glacial lake sequences, Till - lithology

Howell, J.D.

1977 The Use of Soils as a Dating Tool and Climatic Indicator in the Main Ranges, Alberta. Unpublished Masters thesis, Department of Geography, University of Calgary, Calgary, Alberta. (335 pp.)

Soils on moraines and other geomorphic surfaces in the Lake Louise, Moraine Lake, and Bow Lake areas of Banff National Park were examined to evaluate the usefulness of soil profile development as a relative dating tool in this area. Unfortunately, the soils did not fall into distinct age groups, as have been found in the mountains of the western United States, but displayed a continuum with mean values for most variables over-lapping from soil to soil. Although this lessens the usefulness of soils as a dating tool, certain trends can be used to distinguish the moraines. The best of these are solum thickness and B horizon thickness, both of which increase with increasing age of the soil. The soils become more complex with increasing age and the horizon sequence and soil subgroups present are also useful in separating the moraines. Organic matter content for both the A and B horizons shows an initial increase followed by a decrease. A similar trend is observed with organic-complexed iron plus aluminum in the podzolized B horizon. The difference of pH, in water, between the B and A horizons increases with increasing age of the soil. The value for the percent the standard deviation is of the mean for a number of variables is also a useful criterion. Many soil properties, including bulk density, particle size, colour, and total iron content, however, do not display a trend and cannot be used to differentiate the moraines. Possible explanations for the greater success of soils as a dating tool in studies in the United States are the closeness in age of the soils in the present study, their longer duration of development and the calcareous nature of the parent materials in this portion of the Canadian Rockies.

The examination of a chronosequence of soils on moraines in the Lake Louise area indicates that the calcareous parent materials hamper soil profile development. The carbonates retard eluviation and illuviation in the soil and profile development proceeds at a slower rate until they are removed. The sequence of soil development on moraines is from Regosols through Brunisols to Podzols, although the latter two co-exist on pre-Neoglacial moraines. The oldest soils show the least variation among themselves, suggesting greater stability with increasing age. Soils developed on quartzite rockfalls display better profile development than those on calcareous moraines of comparable age. Eolian deposition accompanied by increments of volcanic ash was not found to play as important a part in soil development as has been suggested by other workers.

A comparison of the findings in the Lake Louise area with models of environmental change suggests that the early Holocene climate, which was conducive to Podzol development, was followed by one of poorer conditions for their development. These findings agree with those of other workers in the area.

Location : ACU, UARC, ID#1768
ACU, Mic., QE 473. H69 1977
Areas : Map areas - 82 N
Borden areas - EQ
Topics : Soil - chemical properties, Soil - pedogenesis, Soil - physical properties, Tephra - Mazama

Jennings, A.H.
1951 The Glacial Geomorphology of the Sunwapta Pass Area, Jasper National Park. Unpublished Masters thesis, Department of Geology, University of Iowa, Iowa City, Iowa. (99 pp.)

Abstract : No abstract available
Location : IC (University of Iowa, T1951 J54)
Areas : Map areas - 83 C
Borden areas - FQ
Topics : Glacial chronology, Glacial geomorphology

Kostaschuk, R.A.
1980 Late Quaternary History of the Bow River Valley Near Banff, Alberta. Unpublished Masters thesis, Department of Geography, University of Calgary, Calgary, Alberta. (90 pp.)

Surficial deposits in a 39 km^2 area of the Bow River Valley near Banff, Alberta were examined in order to (1) map Late Quaternary sediments in the area, (2) interpret the deposits with respect to their processes, and (3) to postulate a Late Quaternary history of the sediments. Data provided by exposures, auger, split-spoon, and borehole cores, and the stratigraphic position of Bridge River and Mazama volcanic ashes was used to determine the Late Quaternary history.

Late Wisconsin glaciofluvial and glaciolacustrine sediments were deposited in the lower Spray River and Cascade River valleys during the final, Canmore (Rutter, 1972), glacial advance in the Banff area. With the Canmore retreat glacial till and outwash blocked the drainage of the Bow Valley immediately west of Banff, and Lake Vermilion formed in this basin. Evidence for the existence of Lake Vermilion includes thick accumulations of glaciolacustrine sand, silt, and clay, a beach deposit, lacustrine terraces and an aeolian beach ridge. The lake surface reached a maximum elevation of 1410 m in the late glacial, then lowered and stabilized at 1360 m by 6,600 B.P.

Two distinct alluvial fan types are represented in the study area. Debris flow fans composed of large, mud supported clasts were active in the Early Holocene, becoming inactive prior to 6,600 B.P. Fluvial fans composed of well sorted gravels have remained active throughout the Holocene.

Loess deposits are common in the Banff area. Loess deposition rates from 6,600 B.P. to 2,500 B.P. are between 0.17 mm yr^{-1} and O.18 mm yr^{-1}, and from 2,500 B.P. to the present range from 0.16 mm yr^{-1} to 0.23 mm yr^{-1}.

With the stabilization of the lowest stand of Lake Vermilion at 6,600 B.P., a fine grained river-dominated delta prograded from the west and eventually infilled the lake. Coarsening upwards sequences in the cores, the stratigraphic position of Bridge River and Mazama ashes, and surface features such as abandoned distributaries, interdistributary ponds and thick peat accumulations provide the evidence for the delta progradation. The present Vermilion Lakes are interdistributary ponds formed as the delta prograded and minor distributary channels extended north into Lake Vermilion. In modern times, sedimentation into the Vermilion Lakes by flood stages of the Bow River has been retarded by the Canadian Pacific Railway.

Location : ILL
Areas : Map areas - 82 O
Borden areas - EP
Topics : Geomorphology - alluvial fans, Glacial lake sequences, Loess, Sedimentology, Tephra - Bridge River, Tephra - Mazama

Kvill, D.R.
1984 The Glacial Geomorphology of the Brazeau River Valley, Foothills of Alberta. Unpublished Ph.D. dissertation, Department of Geography, University of Alberta, Edmonton, Alberta. (236 pp.)

It is generally accepted that the distal margins of a glacier furnish the greatest amount of information concerning the size and disposition of the ice body. In the Foothills of Alberta the glacial deposits and landform suites indicate that not only is this area where glaciers of both Laurentide and Cordilleran origin terminated during Pleistocene advances, but at least once the two ice masses coalesced and flowed southeastward parallel to the strike of the Foothills. The glacial event during which this coalescence occurred is controversial but many researchers (summarized in Rutter and Schweger, 1980) have expressed the opinion that this happened during Early or Pre-Wisconsin time. This study suggests an alternate model of glaciation in which coalescence occurred during the Late Wisconsin advance. Support for this model is provided by a systematic description and interpretation of the glacial landforms in one area of the Foothills where the Quaternary geology has only been described in a very general study (Reimchen and Bayrock, 1977). It was thought that by directing the primary focus of the study toward geomorphological evidence, rather than glacial stratigraphy, the results could provide supplementary evidence which might assist in the development of a regional model of glaciation. Inconsistencies between the geomorphic and stratigraphic evidence will provide obvious topics for future research.

The interpretation of the geomorphic evidence suggests that Cordilleran ice issued through the Brazeau River valley at least as far as the eastern side of the Foothills. Eskers found within the Foothills indicate that the glaciers were not restricted to the major valley systems and that the ice within these valleys became locally stagnant during deglaciation.

Scattered erratics and erosional evidence suggest that the upper ice limit in the Foothills was at an elevation of about 2000 meters. A dated core of lake sediment from Fairfax Lake, located at the eastern edge of the Foothills, indicates that this area was exposed from beneath glacier ice approximately 12,000 years ago or earlier. Local ice-flow indicators suggests that the last glacier to traverse the eastern region flowed from the northwest, probably from the Athabasca Valley. Perched glaciolacustrine sediments along the Brazeau River valley (near the eastern edge of the Foothills), the pattern of meltwater channels near this area, the orientation of ice-moulded landforms produced by the ice to the east of the Foothills, and a lateral moraine within the easternmost Foothills valley, indicate the contemporaneity of the two ice bodies. Regional topographic constraints, augmented by the interference of the two ice masses, reduced the activity of the ice along the eastern margin of the Foothills during deglaciation. This is evidenced by esker complexes and glaciofluvial deposits on the Western Alberta Plains adjacent to the Foothills. The failure of the ice-moulded landforms, created by the ice flowing from the northwest, to deflect around positive relief features such as the Tertiary Uplands and the eastern edge of the Foothills, indicates that some obstruction was preventing the Cordilleran ice from draining toward the east as local topography would otherwise dictate. Extensive glaciofluvial and glaciolacustrine deposits, large meltwater channels oriented toward the southeast, and tills of mixed Laurentide and Cordilleran origin (mapped in the vicinity of the Brazeau Reservoir east of the study area) indicate that Laurentide and Cordilleran glacier coalesced in this area. Deflection of the Cordilleran ice by the Laurentide Lobe therefore provides a plausible explanation for the observed ice-flow indicators.

The observed landform association can all be explained in terms of a single glacial event. No evidence was found of a subsequent, less-extensive advance except in the high alpine areas. It is therefore concluded that the geomorphic evidence along the Brazeau River valley does not support the theory of the Foothills having escaped glaciation throughout the Late Wisconsin glacial events.

Location : AEU, SPCOLL, Thesis 84F-32D
Areas : Map areas - 83 B, 83 C
Borden areas - FP, FQ
Topics : Glacial chronology, Glacial geomorphology, Ice movement indicators, Pollen analysis, Tephra - Mazama

Leonard, E.M.
1982 Glaciolacustrine Sedimentation and Holocene Glacial History, Northern Banff National Park, Alberta. Unpublished Ph.D. dissertation, University of Colorado, Boulder, Colorado. (287 pp.)

Glacial lake sedimentary records from Banff Park were examined with the aim of clarifying relationships between glacial activity and downvalley sedimentation. Couplets in sediments from two of the lakes provided a method for accurate documentation and dating of recent sedimentation, as analysis of ^{137}Cs content indicated that the couplets are of annual periodicity (varves).

Comparison of sedimentation rate chronologies with glacial activity indicates the existence of an association between high sedimentation rates and periods of increased ice extent and moraine building. During the last 300 years, the two major episodes of moraine building were associated with periods of rapid sedimentation. A third period of high sedimentation rate was associated with rapid ice recession, rather than increased ice extent, indicating that glacial controls on short term sedimentation rate variations are complex, and that variations of a few decades duration do not necessarily bear a close relationship to upvalley ice extent. Available data indicate, however, that sedimentation rate variations of one to several hundred years duration bear a close relationship to ice extent, suggesting that these longer term changes in sedimentation may be of use in reconstructing glacial history.

Sedimentation chronologies spanning several thousand years were constructed for non-varved cores, using organic content, particle size, and mineralogy as indicators of sedimentation rate and glacial sediment output. The chronologies show strong lake-to-lake similarity, indicating that changes in sedimentation were controlled largely by regional glaciological and climatic factors. Rapid sedimentation prevailed before 7000 BP and after 3500-2800 BP, with lower rates during the intervening period, suggesting that upvalley ice was more extensive in the earlier and later portions of the Holocene, and generally least extensive between about 6000 and 3500 BP. In detail, there is indication of glacial advances shortly before 7000 BP, around 4800 BP, between 3500 and 2800 BP, and during the last 1000 years. The most recent of these advances began 800-1000 BP with ice reaching maximum stands at approximately 700 BP and several times during the last 400 years. Ice recessions during the last 2800 years were much less extensive than those of the mid-Holocene.

Location : DAI
Areas : Map areas - 82 N
Borden areas - EQ
Topics : Glacial chronology, Lake cores, Neoglaciation, Sediments - physical properties, Sedimentology

Levson, V.M.
1986 Quaternary Sedimentation and Stratigraphy of Montane Glacial Deposits in Parts of Jasper National Park, Canada. Unpublished Masters thesis, Department of Geology, University of Alberta, Edmonton, Alberta. (187 pp.)

Glacial diamictons described and sampled during regional stratigraphic studies in Jasper National Park, Alberta, Canada, were categorized using a facies approach. The classification scheme was based only on objective field criteria but it was designed to ultimately aid in genetic interpretations of the described deposits which are required for meaningful stratigraphic correlations. It is hoped that the till "facies" described for the Jasper region will be applicable with modifications to other mountain areas, as well as provide a basis for the development of non-genetic classification schemes of glacial deposits in other environments.

Eight main diamicton types and six subtypes were recognized: 1) Massive diamicton (subtype 1a - with rare, steeply dipping sand and gravel lenses and layers; subtype 1b - with rare, plano-convex, sand and gravel lenses); 2) Massive diamicton with abundant striated, faceted and embedded clasts; 3) Banded diamicton; 4) Massive diamicton containing circular sand and gravel lenses; 5) Bouldery diamicton with numerous, highly disturbed, sand and gravel lenses and layers; 6) Massive to moderately stratified diamicton containing trough-shaped, sand and gravel lenses, (subtype 6a - dominantly diamicton with disrupted stratification in the sorted material; subtype 6b - diamicton less dominant and contains abundant undisturbed lenses); 7) Coarse textured diamicton interbedded with sands and gravels (subtype 7a - matrix sandy; subtype 7b - matrix gravelly); 8) Massive diamicton interbedded with horizontally laminated silts and clays.

Environmental interpretations of the glacial diamictons are based on information presently available from process studies in modern glacial environments. The eight types can be grouped into four major genetic categories based on interpretations on the position of formation within a glacier: 1) basal tills (types 1 to 3); 2) englacial tills (type 4); 3) supraglacial tills (type 5); and 4) ice-marginal deposits (types 6 to 8). Till types of the first two genetic categories commonly are vertically and laterally gradational with one another. This basal/englacial sediment association occurs because types 1 to 4 apparently all formed in the basal debris-rich zone (although type 4 diamictons were entirely encased within ice at the time of formation). Contacts between till types 1 to 4 usually are conformable further suggesting a genetic relationship. Similarly, till types 5 to 8 form a supraglacial/ice-marginal sediment association since they usually occur together and grade laterally into one another. Contacts separating till types of the basal/englacial sediment association (types 1 to 4) from those of the supraglacial/ice-marginal sediment association (types 5 to 8) commonly are erosional.

The utility of the facies approach in solving stratigraphic problems was tested by the analysis of a complex sequence of glacial diamictons in the Portal Creek area. The genetic interpretations placed on the facies were validated by a general agreement between the expected and observed facies sequences, and also proved useful in solving stratigraphic problems.

Stratigraphic and provenance studies on the Portal Creek region reveal three major sediment packages of distinct provenance indicating that three separate glacial events may have occurred. However, an environmental analysis of the deposits shows that the oldest two groups of sediment probably were deposited during the same episode. Changes in till provenance are believed to be the result of fluctuations in the dominance of two confluent glaciers originating in different valleys. The facies analysis supports the stratigraphic evidence that the third sedimentary package was deposited in a distinct glacial episode at a significantly later time than the underlying deposits. Although stratigraphic correlations with dated sediments are tentative, both glacial events recorded in the Portal Creek stratigraphic record are presumed to be Late Wisconsin in age.

Location : AEU, SPCOLL, Thesis 86-95
Areas : Map areas - 83 SW
Borden areas - FQ
Topics : Facies studies, Glacial chronology, Quaternary stratigraphy, Till - physical properties

Matt, C.D.

1975 Quaternary History of the Ghost River Area, Alberta. Unpublished Masters thesis, Department of Geology, University of Calgary, Calgary, Alberta. (87 pp.)

The Ghost River, a tributary of the Bow River, is about 20 miles west of Calgary, Alberta. The Ghost Valley was glaciated during the Pleistocene.

Three glacial advances were recognized on the basis of field and air photo study. From oldest to youngest, they have been named Pas de Gog, Devil's Thumb, and Phantom Crag advances. Only one of these advances, the oldest, originated entirely within the Ghost Drainage. The younger two advances were at least partly composed of ice flowing into the Ghost Drainage from the Bow Drainage. The distinction between those deposits from Bow Drainage ice and those from Ghost Drainage ice is based on the presence or absence of Gog Quartzite clasts. The glacial events in the Ghost Drainage have been correlated with those in the Bow Drainage. Radiocarbon dates on bones from terraces downstream suggest that the three advances in the Ghost Drainage were complete by the end of the Pinedale Glaciation.

At several locations in the field, extensive cementation of Quaternary deposits was noted. The cement from these locations was examined in thin section. Calcite was found to be the major cementing agent, and there is evidence for both vadose and phreatic environments of cementation.

Location : ACU, UARC, ID#1836
ACU, Mic., QE 696. M36 1975
Areas : Map areas - 82 O
Borden areas - EP
Topics : Glacial chronology, Till - lithology

McPherson, H.J.

1963 The Glacial Geomorphology of the Upper Red Deer River Valley, Alberta. Unpublished Masters thesis, Department of Geography, University of Calgary, Calgary, Alberta. (41 pp.)

The major purpose of this study was to describe and interpret in terms of process the landforms created during the deglaciation of the mountainous upper Red Deer river valley.

A review of the literature suggested two possible ways in which ice may have retreated during deglaciation. The ice may have retreated in a series of stillstands with recessional positions of the ice marked by end or recessional moraines and associated outwash deposits. Or alternatively, the ice may have stagnated and retreated mainly by melting and lowering in place. This latter idea, first suggested by the Scandinavian school of geomorphologists has been applied to the interpretation of the landforms of the Canadian prairies. Until the present study, however, its possible applicability to alpine landforms in Alberta has not been investigated.

The procedure in this study was to map various kinds of drift in the upper Red Deer valley and to interpret the deposits from the standpoint of deglacial process. In addition detailed studies in the Red Deer river channel were begun. Stakes were placed by plane tabling at a number of localities in the channel with a view to measuring rates of channel erosion and deposition, and the factors controlling these, over a period of several years. Observations reveal differences in the textural and structural character of the deposits, in and around the stream channel in front of the Drummond Glacier and similar deposits located farther downstream. The material close to the ice contains much more poorly sorted and stratified material. Downstream in places, wide alluvial flats occur, and these are composed predominantly of subrounded to rounded stratified and sorted gravels and fines. The presence of poorly stratified and poorly sorted material close to the ice indicates that material of outwash type is not forming in quantity in front of the ice today. This, in turn, suggests that the braided alluvial flats located farther downstream may not be outwash, when the term outwash means proglacial deposits washed out from the ice. Rather the alluvial flats located farther downstream may have been formed by fluvial erosion and deposition some time after ice retreat and some appreciable distance from the ice. Measurements of contemporary erosion and deposition on the alluvial flats, will permit estimations to be made of present day rates of change, and will serve as one kind of check on the idea of "Postglacial" creation of the flats.

Mapping of surficial deposits in the valley reveal the predominance of depositional material considered to have been laid down close to melting ice. This ice proximus material gives rise to either hummocky topography or to a non-paired series of benches which parallel the river in places.

Throughout the valley there exists a paucity of landforms which can be identified as recessional or end moraines, and also of outwash deposits associated with these. This, combined with the predominance of ice proximus material, indicates that the ice retreated not by a series of stillstands during deglaciation, but rather by stagnation and lowering in place.

Location : ACU, UARC, ID#1677
ACU, Mic., QE 697. M24 1963
Areas : Map areas - 82 O
Borden areas - EP
Topics : Glacial chronology, Glacial geomorphology, Sedimentology

Morgan, A.V.
1966 Lithological and Glacial Geomorphological Studies Near the Erratics Train, Calgary Area, Alberta. Unpublished Masters thesis, Departments of Geography and Geology, University of Calgary, Calgary, Alberta. (179 pp.)

This study is an attempt to determine the lithology of tills in the vicinity of the Foothills Erratics Train in order to learn more about the origin of this train, the interrelations between Cordilleran and Laurentide ice sheets, and the glacial history of the Calgary area. Pebble lithology was determined and recorded at 155 sites distributed over the study area, using igneous and metamorphic, carbonate, and brown and purple quartzite pebbles as indicators. Mega-erratics of similar lithology were noted over the entire map region. Isolithological maps were prepared for the respective indicators whilst distribution maps were drawn for the different mega-erratic groups.

In the course of field work on pebble lithology a number of different deposits were mapped. These included widespread lacustrine sediments, spillway systems, shoreline levels, deltas and other indicators of former lake levels, as well as areas of ground and hummocky moraine, glacio-fluvial features, and periglacial structures. Landforms such as drumlins and eskers were also mapped in the field, whilst fluting directions and washboard moraine areas were studies on air photographs.

Conclusions were reached as to the origin of many of the above mentioned features which were also utilized in reconstructing the glacial history of the area. The Foothills Erratics Train possibly originated as a giant rockslide or rockslides onto the surface of a glacier near Mount Edith Cavell, Jasper. The quartzite erratics, many in excess of one hundred tons, were emplaced in the study area during the retreat of the Wisconsin ice, and prior to, or contemporaneous with, glacial Lake Calgary. At least three major glaciers covered the study area, the Cordilleran ice sheet, the Erratics Train glacier and the Laurentide ice sheet. The possibility exists that further glaciers may have been incorporated into the western edge of the Laurentide ice.

A periglacial environment existed during the deposition of waterworked gravels which cap Nose Hill and Cairn Heights. The gravels are believed to pre-date the earliest ice advance but are probably of Pleistocene age. The first glacial advance is thought to be Cordilleran in origin, followed by a Laurentide advance which went at least as far as the western boundary of the study area. The first Laurentide ice sheet was probably over one thousand feet thicker than the Erratics Train glaciers. During deglaciation a series of lakes was trapped between the ice front and the regional slope.

Ice retreat north and eastward is marked by a number of meltwater channels and sandurs, both of which are believed to have been partly ice marginal and partly superglacial. A periglacial climate existed after the retreat of the last ice from the region.

Location : ACU, UARC, ID#1683
Areas : Map areas - 82 NE
Borden areas - EP

Topics : Erratics train, Glacial chronology, Glacial geomorphology, Glacial lake sequences, Till - lithology

Parris, J.H.

1975 The Nature, Extent and Regional Significance of an Unglaciated Zone Between the Ghost and Red Deer River Valley, Alberta. Unpublished Masters thesis, Department of Geography, University of Calgary, Calgary, Alberta. (163 pp.)

This thesis describes the results of an investigation into the existence of an unglaciated area between the Ghost and Red Deer River valleys in the Foothills of Alberta. The objectives were threefold. Firstly, to map the extent of the zone lacking apparent glacial deposits. Secondly, to investigate the zone and the surrounding areas in terms of their weathering mantles and surficial deposits. Thirdly, to offer an explanation for the existence of the purportedly unglaciated zone by relating it to Late Wisconsin ice movement in the surrounding areas.

The majority of the field work was undertaken during the months of June, July and August, 1971. Field methods included mapping the distribution of glacial erratics and analyzing till fabrics. Samples for laboratory analyses were collected from 109 sample sites. Laboratory methods used in studying the samples included grain size analyses, pebble lithologies, chittick calcite/dolomite ratios, heavy minerals and clay mineral analysis techniques. Grain size analyses did not indicate difference in till samples and samples from the area lacking glacial deposits.

Analyses of till samples indicated the presence of three ice masses in the study area during the last period of glaciation. Red Deer Valley ice moved southwestwards along strike valleys as far south as the Burnt Timber Creek in the west of the study area until it lost its momentum or came into contact with northward moving Ghost Valley ice. Ghost Valley ice penetrated no further north than Waiparous Creek. This creek in its headwaters contained a smaller ice mass which barely extended beyond the Rocky Mountain Front.

Calcite/dolomite ratios, heavy mineral and clay mineral analysis proved useful in verifying the boundary of the area lacking glacial deposits which was initially delimited on the basis of the lack of glacial erratics. Results of these techniques did not significantly alter the initial definition of the area. The existence of garnet in till samples and the virtual absence of this mineral in samples from the area lacking glacial deposits proved a valuable criterion for differentiation between deposits of glacial and non-glacial derivation. Chittick calcite/dolomite ratios showed a higher percentage of calcite from till and outwash samples which were composed of locally derived material. Low percentages of the clay mineral montmorillonite and high percentages of illite and chlorite/kaolinite characterised the tills of the study area. Samples from the area lacking glacial deposits had the lowest percentage of illite but the highest percentage of chlorite/kaolinite.

The glacial events in the study area were most probably contemporaneous with the Bow Valley advance described by Rutter (1966a; 1972) who tentatively correlated this advance with the first stade of the Pinedale Glaciation.

Whilst no evidence of glacial deposits was found in the "unglaciated area", certain aspects of the topography suggest that the area may have been glaciated at some earlier time in the Pleistocene.

Location : ACU, UARC, ID#1745
ACU, Mic., QE 186. P35 1975
Areas : Map areas - 82 O
Borden areas - EP

Topics: Glacial chronology, Till - heavy minerals, Till - lithology, Unglaciated terrain

Pheasant, D.R.

1968 The Glacial Geomorphology of the Ya-Ha-Tinda Area, Alberta. Unpublished Masters thesis, Department of Geography, University of Calgary, Calgary, Alberta. (121 pp.)

The study is an attempt to examine the glacial geomorphology of the Ya-Ha-Tinda area in order to determine the sequence of glacial events that have occurred and to determine the processes that have formed the glacial drift in the area.

The techniques used in the study were those of field mapping, aerial photograph interpretation and drift analysis. Four types of drift analysis were used. One hundred samples of drift were analyzed for grain size characteristics, fifty-two samples of till were analyzed for tillstone roundness/angularity characteristics, long axes preferred orientation and lithology composition. A critique of the usefulness of these techniques as they were applied in the study area is included in the summary and conclusion.

It is concluded that the drift in the area could be classified as lodgment till, ablation till, outwash, outwash/fluvial and ice-contact stratified drift. The composition of the lodgment till varied considerably according to the underlying bedrock or unconsolidated deposits. The outwash deposits are divided into two groups, a pre-till outwash which was deposited in river channels by meltwater from an advancing glacier and a post-till outwash which is generally a thin veneer laid down during deglaciation.

Evidence for one major glacial advance is recognized in the Ya-Ha-Tinda. This glacier had a maximum thickness of approximately 2,000 feet and is thought to have occupied the valley for a considerable interval of time. The main valley glacier was still active when it melted and minor local advances and still stands occurred during deglaciation. Evidence is put forward that certain cirques in the area were occupied and modified by glaciers during the subsequent Neo-glacial stades. A chronology is not proposed for the study area but local correlations with previous work are suggested when evidence for comparison is present.

Location: ACU, UARC, ID#1686
ACU, Mic., QE 697. P47 1968
Areas: Map areas - 82 O
Borden areas - EP
Topics: Glacial geomorphology, Till - heavy minerals, Till - lithology

Rutter, N.W.

1966 Surficial Geology of the Banff Area, Alberta. Unpublished Ph.D. dissertation, Department of Geology, University of Alberta, Edmonton, Alberta. (105 pp.)

The study was undertaken to map the surficial deposits in the Banff area and to determine the Quaternary stratigraphy and geological history. The study area comprises a part of the Bow River valley and certain tributary valleys within the Rocky Mountains. Till sheets are rarely in stratigraphic succession and cannot be differentiated on lithological characteristics; therefore reliance was placed on geomorphic criteria and the relationships between tills and other glacial deposits in deciphering the stratigraphy. Laboratory work was conducted mainly to describe the tills, to determine their provenance, and to test methods of correlation. Investigations performed were grain size analyses, roundness of pebbles, pebble composition counts, heavy mineral identification, clay mineralogy, carbonate content and dolomite-carbonate percentages. The laboratory work indicates that all the tills in the Banff area are similar in composition and vary only as the underlying bedrock varies; and that the source of the ice was probably always in the area of the Continental Divide.

Four major ice advances are recorded. The Pre-Bow Valley advance, the earliest recorded in the Banff area, is indicated by outwash underlying the oldest till recognized. This advance is tentatively correlated with the Bull Lake Glaciation of the United States Rockies. The oldest till recognized was deposited during the Bow Valley advance, which extended into the Foothills. Ice-contact fluvial deposits, believed to have been originally kame moraines, indicate at least two times of glacier equilibrium during deglaciation. The Bow Valley advance is inferred to be equivalent in age to the early stade of the Pinedale Glaciation. The Bow Valley re-advance took place from about Banff townsite and probably extended into the Foothills. This event is recorded by erosional surfaces and discontinuous patches of till over outwash. It is correlated with the middle stade of the Pinedale. The next advance, the Eisenhower Junction, extended about as far as Eisenhower Junction. Evidence for it includes well preserved ground and lateral moraines, erosional surfaces, fresh cirques, and a terminal moraine. A minor re-advance followed, as shown by till over ice-contact fluvial deposits laid down during the deglaciation of the Eisenhower Junction advance. A radiocarbon date of 9330±170 years B.P. from a nearby area indicates the age of the Eisenhower Junction advance and re-advance to be about equivalent to the late stade of the Pinedale Glaciation.

The Altithermal interval is indicated by wind-blown material containing a volcanic ash layer tentatively correlated with Mt. Mazama ash. Two levels of cirque development probably followed the Altithermal. This succession, along with cirques at lower elevations which developed earlier, are present in several valleys in the Banff area. End moraines near modern glaciers, or in recently vacated cirques, are located near Horseshoe Glacier, and in Larch Valley; a questionable end moraine occurs near the southwest end of Moraine Lake. These cirques and end moraines correlate with the Neoglaciation. A late nineteenth century advance evidenced by the ice-cored end moraine of the Wenkchemna Glacier is equated with the Gannett Peak stade of the Neoglaciation.

Location : AEU, SPCOLL, Thesis 1966-23D
Areas : Map areas - 82 O
Borden areas - EP
Topics : Glacial chronology, Neoglaciation, Quaternary stratigraphy, Tephra - Mazama, Till - lithology, Till - physical properties

Stene, L.P.
1966 Pleistocene Valley Train Terraces Along the Athabasca River in the Hinton Area, Alberta. Unpublished Masters thesis, Department of Geography, University of Alberta, Edmonton, Alberta. (58 pp.)

Two large paired terraces representing the surfaces of two Pleistocene valley trains are present along the Athabasca Valley in the vicinity of Hinton, Alberta. Both valley trains were deposited and terraced during the retreat of the Cordilleran Obed Glacier, an expanded toe-valley glacier that was the last to occupy the area.

Study of the surficial deposits and interpretation of the glacial history were needed in order to understand the origin of these valley train terraces. The upper valley train was the first to be deposited and it is related to a recessional moraine of the Obed Glacier within the study-area. The rapid retreat of the Obed Glacier from this moraine provided large quantities of meltwater which trenched the upper valley train into paired terraces. The lower valley train was deposited in front of the Obed Glacier when it maintained an undetermined position upstream from the study-area. Further retreat of the glacier resulted in dissection of the valley train and formation of the lower valley train terrace.

Location : AEU, SPCOLL, Thesis 1966-104
Areas : Map areas - 83 F
Borden areas - FQ
Topics : Geomorphology - terraces, Glacial chronology

Tharin, J.C.
1960 Glacial Geology of the Calgary, Alberta Area. Unpublished Ph.D. dissertation, Department of Geology, University of Illinois, Urbana, Illinois. (131 pp.)

Abstract: No abstract available
Location : ADTMP, uncatalogued
Areas : Map areas - 82 NE
Borden areas - EP
Topics : Glacial chronology, Quaternary stratigraphy

Walker, M.J.C.
1971 Late Wisconsin Ice in the Morley Flats Area and the Adjacent Areas of the Kananaskis Valley, Alberta. Unpublished Masters thesis, Department of Geography, University of Calgary, Calgary, Alberta. (114 pp.)

The Morley Flats area of the Bow Valley and the lower ten miles of the Kananaskis Valley, approximately 45 miles west of Calgary, were studied to determine Late-Wisconsin ice movement in this portion of the Rocky Mountain Front Ranges. In particular, attention was directed towards establishing the areal extent of Bow and Kananaskis ice, and the possibility that the two valley glaciers had converged on the undulating plain of Morley Flats.

Detailed field work was complemented by analysis of samples in the laboratory, and the results suggest the following sequence of events. With the onset of the Classical Wisconsin, Bow Valley ice crossed the Morley Flats area as a large piedmont lobe and deposited thick layers of buff-grey till. A number of longitudinal ridges which occur on the Flats are interpreted as drumlins which are thought to have formed by a process of accretion during this glacial phase. Rutter (1965) tentatively correlated this advance of Bow Valley ice with the early Pinedale Stade recognised by Richmond (1965) in the northern U.S.A.

Analysis of deposits in the Kananaskis Valley indicates that the lower ten miles of the valley were occupied by Bow ice at this period, the ice being of the order of 2500-3000 feet in thickness. No evidence could be found for the former presence of Kananaskis ice in the study area.

Wasting and thinning of the ice produced a lake in the lower Kananaskis Valley which was dammed by Bow ice occupying the Morley Flats to the north. Progressive lowering of the ice barrier led to the formation of a series of channels and spillways, allowing water impounded in the valley to escape initially eastwards into the Elbow River drainage system and finally northwards into the valley of the Bow River. It is suggested that the post-glacial course of the Kananaskis River occupies the lowest of these channels.

Location : ACU, UARC, ID#1711
ACU, Mic., QE 697. W34 1971

Areas: Map areas - 82 O
Borden areas - EP
Topics: Glacial chronology, Glacial geomorphology - drumlins, Glacial lake sequences

c. Northern Western Corridor

Jones, J.F.

1961 Surficial Geology and Related Problems, Beaverlodge District, Northwestern Alberta. Unpublished Masters thesis, University of Western Ontario, London, Ontario. (152 pp.)

In the Beaverlodge district the last continental glaciation of Wisconsin age covered preglacial sand and gravel with thick deposits of till. Deglaciation at the end of Wisconsin time produced features characteristic of mass-stagnation in eastern and central Alberta, whereas in northwestern Alberta meltwaters became impounded against a retreating ice-front producing extensive proglacial lakes and associated deposits. Early stages of the ice melting formed glacial beach deposits on a highland. Stream trenches formed at lower elevations than the beaches were later covered by glacio-lacustrine deposits, the result of an ice-advance outside the Beaverlodge district, which again impounded the escaping meltwaters. The ice withdrew and the proglacial lakes drained.

Early stages in the formation of the Wapiti River in postglacial time produced paired terraces. Later U-shaped sand dunes were formed. Postglacial differential uplift of the Beaverlodge and nearby areas is estimated at 7.5 feet per mile to the southwest towards the Rocky Mountains.

Till and lacustrine materials of the map-area are distinguished on the basis of carbonate analyses of the minus 200 mesh grade, with the lacustrine material being slightly enriched and averaging 10.4 per cent carbonates and the continental till averaging 7.3 per cent total carbonates.

Heavy mineral analyses indicate at one locality that the heavy mineral fraction of the till is well mixed. Pebble counts show regional variations.

X-ray analyses of dark layers of varved clays contain montmorillonite, chlorite, illite and quartz, while the light layers contain predominantly chlorite, illite, quartz and calcite. Carbonate, mechanical and heavy mineral analyses were checked for statistical significance.

Note : Abstract only published in Canadian Mining Journal 82:109
Location : AEU, SCI, TN 1. C21 (Abstract only)
Areas : Map areas - 83 M
Borden areas - GQ
Topics : Glacial chronology, Glacial lake sequences, Sediments - clay mineralogy, Till - heavy minerals, Till - heavy minerals

d. Southeastern Alberta and Southern Saskatchewan

Catto, N.R.

1980 Quaternary Geology of the Western Cypress Hills Region, Alberta and Saskatchewan. Unpublished Masters thesis, Department of Geology, University of Alberta, Edmonton, Alberta. (239 pp.)

The Western Cypress Hills region was glaciated at least three times during the Quaternary. Throughout this time, the surface of the Cypress Hills Plateau remained unglaciated.

The most extensive of the glacial events, Phase A, occurred some time prior to the Wisconsin. Phase B ice, of Illinoian or early Wisconsin age, covered much of the region and was responsible for the formation of Lake Wild Horse and several lakes in the Pakowki basin during its retreat.

Phase C ice, of Late Wisconsin age, achieved a maximum position marked by a pronounced moraine extending northeast from Etzikom, Alberta, to a position south of Medicine Hat and thence easterly to Irvine and Walsh, Alberta. This phase marked the maximum extent of Late Wisconsin ice into the region. Isostatic depression of the Pakowki basin at this time produced a second series of lakes.

Retreat of the Phase C glacier was followed by a period characterized by a gradual climatic amelioration, which climaxed between 8500 and 7000 B.P. Climatic conditions then altered, and a cooler, moister period began, which continues to present.

Location : AEU, SPCOLL, Thesis 81-18
AEA, HSS/ASA, 551.79 C279
Areas : Map areas - 72 E, 72 L, Saskatchewan - Cypress Hills
Borden areas - DO, EO, region as above
Topics : Glacial chronology, Glacial lake sequences, Quaternary stratigraphy

David, P.P.

1964 Surficial Geology and Groundwater Resources of the Prelate Area (72 K), Saskatchewan. Unpublished Ph.D. dissertation, Department of Geological Sciences, McGill University, Montreal. (329 pp.)

The Prelate area comprises 6,000 square miles in southwestern Saskatchewan adjoining the Alberta boundary north of latitude 50°. Glacial drift which is as thick as 450 feet in two north trending preglacial valleys, overlies shale, sandstone, sands, conglomerates and gravel formations ranging from Late Cretaceous to Early Pleistocene age. Borings and exposures along South Saskatchewan River reveal five till sheets separated by stratified deposits: three till sheets correlate with end moraines within the area. Deposits of several glacial lakes cover much of the area and overlap each other; these lakes discharged successively through spillways to the south, east and north. Dune sand and loess were laid down mainly in post-glacial time. A radiocarbon date on humus from the Prelate Ferry paleosol formed on a lower till indicates that the last ice sheet advanced into the area about 20,000 years ago. Fossil gastropod shells from the surface of the upper till date the retreat of the last ice sheet at about 10,250 years ago.

Ground water occurs in sand and gravel aquifers in the drift and in the Cypress Hills, Bearpaw, and Belly River formations. The Belly River aquifer is artesian and is used in the northern part of the area. The ground water contains from 340 to 5,500 parts per million of dissolved solids. Water from the drift ranges from sulphate to sulphate-bicarbonate in type;

the Belly River aquifer yields sulphate water.

Location : ILL, McGill University Library (AS42 M3)
Areas : Map areas - 72 K, Saskatchewan - Southern
Borden areas - region as above
Topics : Analysis of radiocarbon dates, Geomorphology - dunes, Glacial chronology, Groundwater resources, Loess, Molluscs, Palaeosols, Quaternary stratigraphy, Till - lithology

Proudfoot, D.N.
1985 A Lithostratigraphic and Genetic Study of Quaternary Sediments in the Vicinity of Medicine Hat, Alberta. Unpublished Ph.D. dissertation, Department of Geology, University of Alberta, Edmonton, Alberta. (248 pp.)

The Medicine Hat area of southeastern Alberta contains some of the most complete exposures of Quaternary sediment in the Plains region of North America. It is also well known for the wealth of fossil material interpreted by other workers to represent fauna that lived during preglacial and interglacial times. This study was conceived to take advantage of these factors in order to develop a lithostratigraphic framework for Pleistocene sediment in the area so that the stratigraphic sequence and chronology could be correlated with adjacent areas.

The similarity in diamicton grain-size distribution, clay mineralogy, and coarse sand lithology examined within this study do not allow subdivision and correlation of stratigraphic units. A study of lithofacies, however, in particular diamicton, and delineation of a major unconformity, provided a solution. This involved the development of a lithofacies classification that centres around diamicton and associated lithofacies. The classification is based primarily on the presence or absences of layering, stratification or unlithified inclusions. The six most important lithofacies in this classification include: (i) unlayered diamicton (subglacially deposited); (ii) stratified diamicton (more than 80 percent diamicton with thin interbeds of sand and silt) deposited by debris-flows, underflows, and by rain out; (iii) diamicton containing lenses (more than 70 percent diamicton that contains large sand and silt lenses) deposited from a supraglacial position by melting out; (iv) deformed stratified diamicton formed by injection of sediment and collapse as buried ice melted out; (v) layered diamicton (composed of highly attenuated layers) formed by subglacial molding, melting out and lodgement; (vi) interbedded diamicton, sand, and silt (less than 80 percent diamicton with thick beds of sand and silt) deposited proglacially by subaquatic slumps, debris-flows and density underflows.

The lithostratigraphic framework includes four formations. The oldest is the Empress Formation, which contains three members. The lower member is fluvial quartzitic sand and gravel containing material derived from the Canadian Shield and is of preglacial age. It is sharply overlain by fluvial silty clay and sand of the middle member. The upper member is a fining upward sequence of sand and silt topped by silt and clay rhythmites, which was deposited in a proglacial lake that formed as an advancing glacier (the beginning of the Phase One Glaciation) blocked the regional drainage. Till of formation A containing granitic and mafic rocks derived from the Canadian Shield overlies these rhythmites. It has a predominantly subglacial origin. Formation A is unconformably overlain by a gravel fluvial lag and sand of the lower member of formation B. The middle member is likely an interglacial or interstadial deposit. Where this member gradationally overlies the lower member, sandy silt occurs in channels that are incised into the top of formation A. Elsewhere, it is composed predominantly of layered and stratified diamicton that sharply overlies the lower member. This member is interpreted as proglacial lake sediment and represents the beginning of the Phase Two glaciation. It was overridden by a glacier that deposited the upper member of formation B, unlayered diamicton, subglacially. As the Phase Two deglaciation occurred, diamicton containing lenses was deposited from the top of the basal debris zone. Thin silt and clay rhythmite beds form the base of formation C, which overlies formation B. They were deposited in a short-lived proglacial lake. Subsequently, sand, silt and diamicton of formation C were deposited during postglacial and Holocene times.

Location : AEU, SPCOLL, Thesis 85F-58D
Areas : Map areas - 72 E, 72 L
Borden areas - DO, EO
Topics : Diamicton - lithology, Glacial chronology, Glacial lake sequences, Sedimentology

Westgate, J.A.
1964 The Surficial Geology of the Foremost-Cypress Hills Area, Alberta, Canada. Unpublished Ph.D. dissertation, Department of Geology, University of Alberta, Edmonton, Alberta. (208 pp.)

The Foremost-Cypress Hills area is divided into six physiographic units: Cypress Hills Plateau, upland areas, till plain, lacustrine plains, river channels, and canyons. The South Saskatchewan River drains the northern part of the area, and the Milk River drains the southern part. A small internal drainage basin is centred on Lake Pakowki.

Glaciation only slightly modified the preglacial physiography of the upland areas but considerably altered that of the lower tracts. The preglacial valleys in places contain more than 250 feet of glacial drift. The Ancestral Oldman River and the Ancestral Milk River drained the map-area in preglacial times; both occupied broad, open valleys and flowed to the northeast.

End moraine, including washboard moraine, is the most widespread glacial land form. Others present include ground moraine, hummocky disintegration moraine, linear disintegration ridges, drumlins and drumlinoid ridges, kames, eskers, and flutings. Proglacial land forms present in the areas include outwash aprons, a loess plain, glacial lake basins, meltwater channels, and spillways.

The colour, texture, pebble composition, heavy minerals, and carbonate content of the several till sheets in the map-area were studied. The texture of the tills is largely controlled by the underlying bedrock, and the younger tills contain less carbonate pebbles than the older. The carbonate content of the till matrix, and the heavy minerals must presently be regarded of little value as parameters in differentiating the till sheets.

The maximum altitude reached by the Laurentian glaciers in the map-area was 4500 feet. At this time the ice was 2300 feet thick at Medicine Hat, about 1500 feet thick at Foremost and Manyberries and about 1000 feet thick at Aden. In the western part of the area the glaciers moved southward, but farther east they were forced to flow southeastwards along the stretch of low land between the Cypress Hills and the Sweet Grass Hills, which both stood as nunataks at the time of the most extensive glaciation.

The Pleistocene deposits are divided into the following stratigraphic units, in order of decreasing age: Saskatchewan gravels and sands; sediment deposited in proglacial lakes that formed along preglacial valleys as a result of damming downstream by ice; pre-Wild Horse drift, including the Cypress Hills loess; Wild Horse drift; Pakowki drift and Manyberries volcanic ash; Etzikom drift and Oldman drift. The drift sheets are morphostratigraphic units; all were deposited at the time of a significant glacial advance. A radiocarbon date of

29,200±8100/4000 years B.P. (GX-0102) on the upper part of the preglacial Saskatchewan gravels and sands, the lack of severely weathered horizons in the drift, and the fresh-looking morainal topography suggest that all these drift sheets are of Wisconsin age.

Location : AEU, SPCOLL, Thesis 1964(F) #27D
Areas : Map areas - 72 E
Borden areas - DO
Topics : Glacial chronology, Glacial geomorphology, Till - heavy minerals, Till - lithology, Till - physical properties

e. Central and East-Central Alberta

Craig, B.G.

1956 Surficial Geology of the Drumheller area, Alberta, Canada. Unpublished Ph.D. dissertation, University of Michigan. (145 pp.)

The Drumheller area lies in south-central Alberta about 80 miles northeast of Calgary. The field study was carried out as part of the mapping program of the Geological Survey of Canada.

Shales and sandstone of Upper Cretaceous and Paleocene age underlie the area. Elevated plateaux, capped with Late Tertiary gravel derived from the Rocky Mountains, remain from a former Tertiary erosion surface. The gravel is thinner but more extensive than previously supposed. Comparison of this gravel with similar gravel elsewhere on the prairies indicates that it is correlative with the early Pliocene Flaxville gravel.

The Pleistocene deposits are divided on the basis of environment of deposition into four major groups that consist of glacial deposits, ice-contact deposits, lacustrine deposits, and fluvial deposits. The glacial deposits are composed of clay till deposited directly from glacial ice. The end moraine was formed over widespread areas by processes of ablation and does not represent accumulation of debris at the ice front. Deposition of end moraine was confined to certain elevations by early stagnation at high altitudes within the area. Stagnant ice features composed of till, lacustrine sediments, and gravel occur as flat elevated areas within the end moraine. They were formed in part by deposition of water-transported material in small ice-bound lakes. Ground moraine composed of clay till covers much of the area, but on the Hand Hills the till in the ground moraine contains much Tertiary gravel. Some areas of ground moraine have been reworked by water. The ice-contact deposits are composed of material that was deposited by meltwater in juxtaposition with glacial ice. They consist of outwash, eskers, and kames, and are not extensive. Lacustrine deposits, which consist of sand, silt, and clay, were deposited in glacial-lake basins. Clay and sand are most extensive although some silt is found in the vicinity of Drumheller. The fluvial deposits consist of alluvium deposited in meltwater channels that served to drain both the melting ice and the glacial lakes. The location and shape of these channels is important in the interpretation of the glacial history.

A blue till, older than and easily distinguishable from the common clay till, occurs in a few sections along the Red Deer and Rosebud Rivers. It is overlain locally by interglacial sand and clay till, and elsewhere has been contorted by a subsequent glacier.

The Pleistocene glaciers did not modify the preglacial topography to any great extent. Flutings and drumlinoid ridges indicate that the last glacier moved southerly to southeasterly. This glacier overrode the whole area. It retreated by northeastward melting of its margin and by local stagnation and melting on high land. The retreating margin blocked normal eastward drainage and successively lower lakes were formed as it melted back downslope and lower outlets were opened.

Location : AEPAA, 557.123 C844
Areas : Map areas - 82 P
Borden areas - EP
Topics : Glacial chronology, Glacial lake sequences, Quaternary stratigraphy

Duff, D.E.

1951 Some Analyses of Pleistocene Deposits in the Edmonton Area. Unpublished Masters thesis, Department of Geology, University of Alberta, Edmonton, Alberta. (46 pp.)

This thesis embodies the results of a detailed investigation of the sands and sand fractions of till sheets of Pleistocene age in the Edmonton map-area to ascertain if a correlation of these sands and till sheets is possible.

Observed field data, mechanical analyses, histograms, graphs, heavy minerals and sphericity-roundness data are the methods of approach utilized in attempting this correlation and the various techniques employed in this investigation are described.

The investigation reveals the presence of three distinct till sheets and two sets of interglacial beds. Histograms and sphericity data present a possible means of correlating the till sheets but no method of correlating the interglacial sands was effected by the methods of investigation utilized in this study.

Location : AEU, SPCOLL, Thesis 51-13
Areas : Map areas - 83 H
Borden areas - FP
Topics : Till - heavy minerals, Till - physical properties

Ellwood, R.B.

1961 Surficial Geology of the Vermilion Area, Alberta. Unpublished Ph.D. dissertation, Department of Geology, University of Illinois, Urbana, Illinois. (131 pp.)

Abstract: No abstract available
Location : ILL, ACSP, QE 699. A3 347
Areas : Map areas - 73 E
Borden areas - FQ
Topics : Fabric studies, Glacial chronology, Glacial geomorphology, Quaternary stratigraphy

Emerson, D.

1977 The Surficial Geology of the Cooking Lake Moraine, East-Central Alberta, Canada. Unpublished Masters thesis, Department of Geology, University of Alberta, Edmonton, Alberta. (116 pp.)

The Cooking Lake moraine of east-central Alberta is comprised of two till units which were deposited during two phases of continental ice sheet disintegration. A radiocarbon date of 52,000 ± 1760 years B.P. on wood taken from above the lower till in the Fort Assiniboine region suggests the older of the two tills to be early Wisconsin in age. A bedrock high, composed of several upper Cretaceous marine facies, forms the nucleus around which break-up of the two ice advances took place.

The two tills of the moraine are differentiated on the basis of colour, structure, and clay mineralogy. Both were deposited from ice sheets which moved into the area from the Shield to the north-east. Other analytical data including texture, lithology (1-2 mm and 10-15 cms fractions), "heavy," "light" and trace element mineralogy and carbonate content cannot be used to differentiate the tills of the area.

The origins of several till depositional landforms which comprise the physiography of the moraine, are shown on the basis of field evidence to incorporate the theories of Gravenor (1955), Stalker (1960) and Clayton (1967). No correlation was found between the density and relief of prairie mounds over the area with bedrock topography.

Radiocarbon dates on shell material taken from superglacial lacustrine sediments indicate that meltwater was present for approximately 2,000 years after ice of the second continental ice sheet had disappeared. Oxygen isotopes of the shells also show that evaporation was intense throughout the area during late glacial to early postglacial time.

Location : AEU, SPCOLL, Thesis 77F-48
Areas : Map areas - 83 H
Borden areas - FP
Topics : Glacial geomorphology - moraines, Glacial geomorphology - mounds, Molluscs, Oxygen isotope studies, Quaternary stratigraphy, Till - lithology, Till - physical properties

Hughes, G.M.

1962 **The Glacial History of the Redwater and Morinville Areas, Alberta. Unpublished Ph.D. dissertation, Department of Geology, University of Illinois. (126 pp.)**

The preglacial bedrock surface of central Alberta was formed under semi-arid conditions on soft Upper Cretaceous shale and sandstone, and consists of broad uplands sloping gently down to river valleys which may or may not be sharply incised.

During Pleistocene time the ice advanced across central Alberta from the northeast up the regional slope; retreat was by massive stagnation, with melting occurring first in the south and west.

The major lithologic units mapped in the area consist of till and ice-contact glacio-fluvial deposits, which were laid down during the earliest phase of stagnation, followed by Lake Edmonton sediments, and fluvial deposits. Finally, after most of the ice in the area had melted, parabolic and longitudinal sand dunes were formed by northwesterly winds.

Till is present above the bedrock over almost the entire area. The average of seven mechanical analyses shows that this till consists of 2% coarser than sand, 38% sand, 31% silt and 29% clay. The clay fraction is 89% montmorillonite, primarily bentonite, 9% illite and 2% kaolinite. Much of this till was derived from the local Cretaceous bedrock. In many exposures the upper part of the till is brown and the lower part grey. The clay minerals and carbonate content of both grey and brown tills are the same, and examination of the boundary between them leads to the conclusion that the brown till is the oxidized part of the grey till.

The term "ice-contact glacio-fluvial deposits" is applied to an unusual unit that was deposited by a superglacial stream. They form a belt of bedded sands and silts with a pitted surface resulting from the melting of blocks of ice which were included within these sediments.

The deposits of Lake Edmonton, a large proglacial lake which extended far to the south and west of the map area, consist mainly of thin alternating beds of silt and clay.

Fluvial sand deposits extend from the central part of the map area for twenty miles to its eastern boundary and for an unknown distance beyond the area to the east. These sands were deposited by one or more floods of water which crossed the area from the northwest to the southeast, scouring the surface to form smooth to gently undulating uplands cut by a number of deep, parallel valleys. The glacial deposits to the north and east are as yet unmapped, but since this scouring extends into these areas, it will be an important factor in the interpretation of their glacial histories.

No evidence was found which would indicate that this area was affected by more than one ice advance.

Location : DAI
Areas : Map areas - 83 H
Borden areas - FP
Topics : Glacial chronology, Glacial lake sequences, Quaternary stratigraphy, Till - clay mineralogy, Till - physical properties

Hughes, G.M.

1958 A Study of Pleistocene Lake Edmonton and Associated Deposits. Unpublished Masters thesis, Department of Geology, University of Alberta, Edmonton, Alberta. (60 pp.)

The Pleistocene sediments in the vicinity of the City of Edmonton were mapped on a scale of two miles to one inch. The results of this mapping, combined with a study of aerial photographs and some mechanical analyses, were used in an effort to determine the history of the lake, defined as Lake Edmonton, which existed in this area during the retreat of the continental ice sheet, and the genesis of deposits associated with this lake.

Lake Edmonton deposits were found to have covered an area of approximately 870 square miles within the map area, and to have extended an undetermined distance beyond the map area to the north, south and possibly the west. Lake Edmonton was blocked by glacial ice on its eastern shoreline and probably, in part, on its northern and southern shoreline.

The history of Lake Edmonton was divided into two stages. Stage I began when the wasting of the continental ice sheet had proceeded far enough to permit the deposition of the first permanent lacustrine materials within the area, and finished with the incision of the Gwynne Outlet and partial draining of the lake. Stage II began at this point and ended when further wasting of the ice in the northeast permitted complete draining of the lake.

Lake deposits of Stage I consist of material derived from the adjacent ice and from the large delta built into the lake from the west. Deposits of Stage II also consist of material from the adjacent ice and a lesser amount from the delta to the west. Earlier deposits were modified by the drop in lake level caused by the incision of Gwynne Outlet, the action of inwash waters from the west and later wind action.

Location : AEU, SPCOLL, Thesis 1959 #15
Areas : Map areas - 83 H
Borden areas - FP
Topics : Glacial lake sequences

Jones, N.

1981 Glacigenic Streamlined Landforms near St. Paul, Alberta. Unpublished Masters thesis, Department of Geography, University of Alberta, Edmonton, Alberta. (146 pp.)

The Lac la Biche fluting and drumlin field originates at Lac la Biche, Alberta, and extends southeastwards almost to North Battleford, Saskatchewan, a distance of approximately 390 km. The northwest-southwest orientation of the field is transverse to the regional northeast to southwest ice flow direction of the Laurentide ice sheet in Alberta. The Lac la Biche field appears to be a result of a late resurgence of a stream of Wisconsin ice during deglaciation of this region about 11,000 years ago, and aerial photograph evidence shows it to be contemporaneous with an ice stream from the Cold Lake area to the northeast. The two ice streams converged just north of St. Paul, Alberta and flow continued to the southeast. The purpose of this investigation is to determine the genesis of the glacial landforms in the Lac la Biche field.

Field investigations, including till fabric, texture and lithology show evidence of widespread glaciotectonic activity illustrating frozen-bed conditions and compressive ice flow probably ensued at some point during ice advance. The smooth streamlined appearance of drumlins and flutings indicates a transition into wetbased conditions and, possibly, extending flow. A general interpretation holds that initial frozen-bed conditions and compressive flow caused glacial thrusting and plucking of blocks of basal debris near the margin of ice. The blocks lodged at the glacier bed and resisted further movement. With continued advance, thawed-bed conditions were encountered and deposition in a low pressure zone created in the lee of these obstacles occurred. Lateral transport of debris in the lee of the blocks was accomplished as a result of converging secondary flow cells created by the basal pressure gradient. Some till fabric analyses show a 'herring-bone' fabric pattern supporting the existence of converging secondary flow.

Auger holes drilled through three flutings, numerous road cut examinations and subsequent till textural and lithologic analyses, show only one till is present in the streamlined landforms. This reduces the validity of any hypothesis to explain the landforms which requires the addition of two or more till layers during consecutive ice advances. It is concluded the entire formation of the drumlins and flutings occurred during a single ice advance.

Location : AEU, SPCOLL, Thesis 81-63
Areas : Map areas - 73 E, 73 L
Borden areas - FO, GO
Topics : Glacial geomorphology - drumlins, Glacial geomorphology - flutings, Glacial history, Ice movement indicators, Periglacial features, Till - fabric, Till - lithology, Till - physical properties

Ramsden, J.

1970 Till Fabric Studies in the Edmonton Area, Alberta, with Special Emphasis on Methodology. Unpublished Ph.D. dissertation, Department of Geology, University of Alberta, Edmonton, Alberta. (205 pp.)

As part of a continuing program of Quaternary stratigraphic studies in the Edmonton area, Alberta, till fabric determinations were made in an attempt to distinguish the till units. As the local stratigraphy became established, emphasis of the till fabric work was changed to concentrate on (1) examination of possible models for the statistical treatment of till fabrics, (2) investigation of the problems of determining the pebble fabric at an exposure and of interpreting the fabric pattern, (3) evaluation of till fabrics as an aid to local stratigraphic studies, and (4) establishment of local ice-movement directions.

Two mathematical models were examined to determine their value as bases for calculating descriptive statistics to represent till fabric data. A previously used model, that of a single axially symmetric spherical normal (Fisher) distribution, was examined and found unsuitable since most fabrics encountered were not unimodal. The testing of a model consisting of several Fisher distributions, one corresponding to each mode of the fabric, revealed that most of the fabric modes lacked axial symmetry.

The orientation of 550 elongate pebbles from a 300-foot exposure of a single till unit (six feet thick) revealed that: (1) The fabric varied both laterally and vertically, but when samples were taken together they showed a preferred trend parallel to groove molds at the base of the till. (2) Larger pebbles exhibited less scatter in their orientations than did smaller ones. (3) The orientation of the a-axis of a pebble was in part determined by the elongation of the pebble.

Pebble fabrics appear to be of little help in the recognition and differentiation of Quaternary stratigraphic units in the Edmonton area.

Upper till fabrics are consistent with ice movement from the north-east as indicated by sole markings and surface features. Transverse fabrics were found at four out of 10 locations.

The direction of movement of the glacier that deposited the lower till cannot be reliably determined from the fabric evidence presented here. Interpretation of lower till fabrics is made difficult by the fact that deformation of this deposit occurred when the area was overridden by the glacier that laid down the upper till. Distinction between primary and wholly or partially altered lower till fabrics is a major problem in the study of lower till fabrics.

Location : AEU, SPCOLL, Thesis 1970F No. 220
Areas : Map areas - 83 H
Borden areas - FP
Topics : Ice movement indicators, Quaternary stratigraphy, Till - fabric, Till - fabric - evaluation of measurement methods

f. Northern Alberta

Andriashek, L.D.

1985 Quaternary Stratigraphy of the Sand River Area, NTS 73L. Unpublished Masters thesis, Department of Geology, University of Alberta, Edmonton, Alberta. (368 pp.)

Eight glacial and non-glacial formations have been defined for the Quaternary sequence in the Sand River area. The thick drift cover, combined with a paucity of exposures, necessitates reliance on testhole data for the differentiation and correlation of these units. The stratigraphy of the upper 50 m is defined primarily from matrix texture and carbonate content, and 1-2 mm sand composition data derived from dry auger samples at 1 m intervals. Rotary drill samples and electric log responses are essential to define the deeper stratigraphy.

The relative abundance of four rock groups (igneous and metamorphic, quartz, carbonates and local bedrock) within the 1-2 mm sand fraction is the most useful criteria in differentiating the till. The proportion of these rocks commonly show a systematic change with distance from the source, consequently a ratio of their abundance, rather than the absolute percentages, is used to differentiate the tills within a local sequence. The standardization of electric log responses with the analytical values enable correlations of the units beyond areas where samples were collected. Textural and lithologic variations allow the division of some formations into units or members.

The formations have been informally defined with designated type sections. The Empress Formation is the oldest, and is divided into three units on the basis of lithology: unit 1, preglacial sand and gravel, unit 2, silt and clay, and unit 3, glacial sand and gravel. The Bronson Lake Formation overlies the Empress Formation. It consists of clayey till and clay deposited by the first recognized glacier in the area, the Cherry Grove Glacier. Glaciofluvial sand and gravel of the Muriel Lake Formation were deposited on top of the Bronson Lake Formation, following the retreat of the Cherry Grove Glacier, and during the advance of the Fort Kent Glacier. Till of the Bonnyville Formation overlies the Muriel Lake Formation. It was deposited by the Fort Kent Glacier, and is characterized by a relative abundance of quartz, and a paucity of carbonate in the 1-2 mm sand fraction.

Glaciolacustrine silt and clay of the Ethel Lake Formation were deposited in proglacial lakes during the advance of the Ardmore Glacier. Till of Marie Creek Formation was deposited by the Ardmore Glacier, overtop the Ethel Lake Formation. The till is characterized by a relative abundance of carbonate rocks, mainly dolostone, in the silt-clay and 1-2 mm sand fractions.

Glaciofluvial sand of the Sand River Formation was deposited following the retreat of the Ardmore Glacier and during the advance of the Cold Lake Glacier.

The Grand Centre Formation consists of till and glacially displaced sediment deposited by the Cold Lake Glacier. The till is characterized by an abundance of igneous and metamorphic rock fragments in the 1-2 mm sand fraction.

Oxidized profiles on the surface of the till formations suggest that lengthy periods of weathering followed each major glacial episode.

Location : AEU, SPCOLL, Thesis 85-5
Areas : Map areas - 73 L
Borden areas - GO
Topics : Buried valleys, Drilling, Glacial chronology, Glacial lake sequences, Ice movement indicators, Quaternary stratigraphy, Till - clay mineralogy, Till - lithology, Till - mineralogy, Till - physical properties

Gold, C.M.

1978 Quantitative Methods in the Evaluation of the Quaternary Geology of the Sand River (73 L) Map Sheet, Alberta, Canada. Unpublished Ph.D. dissertation, Department of Geology, University of Alberta, Edmonton, Alberta. (462 pp.)

The Sand river map sheet, located in east-central Alberta, possesses several bedrock channels buried beneath Quaternary glacial deposits and known only from drill hole information. A total of 995 samples from 78 drill holes were analyzed for 22 compositional properties in an attempt to delineate the stratigraphy of the till units present. The measurements included granulometry, grain lithology, calcium carbonate equivalent and bulk (major and minor element) chemistry. A reliable, rapid, constant-volume carbonate analysis apparatus was developed for the project. Bulk chemistry was performed by fusing till samples into glasses and analyzing them using energy-dispersive electron microprobe techniques. The correction procedures required for quantitative energy-dispersive analysis are described in some detail, along with EDATA, a computer program for applying them. Corrections are applied for atomic number, absorption and fluorescence effects, instrumental calibration corrections, background (X-ray continuum) shaping and fitting as well as peak overlaps.

Problems are often encountered in contour mapping of irregularly spaced data points by computer, and new techniques has been devised and implemented in the TRIMAP package, based on subdividing the map area into triangles. Features include the use of triangular element data structures, a local homogeneous coordinate system, the automatic generation of a triangular network, the selection of a suitable triangle optimization criterion and the choice of a suitable smooth interpolant over individual triangular domains.

Four distinct till units were distinguished in the study area on the basis of their compositions. A high carbonate middle till separates an upper and a two member lower till. The compositional parameters of these tills were categorized as textural, erratic or local. In the fine fraction of a till unit, vertical compositional variation was low by comparison with lateral variation, which appeared to be related to sub-ice topography. The glacial history proposed relates the four suggested ice advances to the varying regional drainage as indicated by the major bedrock channels. The regional topography at each stage was estimated. Compositional analysis of tills, as well as the topographic reconstruction of stratigraphic boundaries, is important in studies of glacial history.

Location : AEU, SPCOLL, Thesis 78-18D
Areas : Map areas - 73 L
Borden areas - GO
Topics : Buried valleys, Drilling, Glacial chronology, Glacial lake sequences, Ice movement indicators, Quaternary stratigraphy, Till - clay mineralogy, Till - lithology, Till - mineralogy, Till - physical properties

Henderson, E.P.

1952 Pleistocene Geology of the Watino Quadrangle, Alberta. Unpublished Ph.D. dissertation, Department of Geology, Indiana University, Indiana. (92 pp.)

Preglacial erosion in the Watino quadrangle produced a more mature topography than the present one, with broad valleys and long gentle slopes leading to upland areas. Glaciation tended to fill basins with glacial, glacio-fluvial and glacio-lacustrine sediments, while eroding the highlands and leaving them with a relatively thin veneer of till. Post-glacial erosion has resulted in dissection of the broad, lower areas with the development of steep-sided, deep valleys along the main streams and the lower parts of their tributaries. In places the rivers have re-excavated their old channels and removed the till and stratified deposits which filled them. Glacial sediments in these old valleys are as much as 700 feet in thickness.

Direct evidence of at least three invasions by Keewatin ice consists of three tills of varying lithology and texture. A possible fourth till is exposed at one location overlying basal gravels which cover the bedrock in places. The basal gravels were laid previous to the first glaciation of the area by meltwater from Cordilleran ice on the Rocky Mountains to the west. Ice which invaded the area apparently came principally from the northeast.

A severe periglacial climate resulted in widespread development of periglacial deposits; dunes, disturbed silts and clays and till and silt mounds of large size were evolved through severe frost action. The mounds evidently are of a polygenetic origin. Bulging of soil polygons by lateral pressure from growing ice wedges and local upheaval of plastic material during freezing of an active layer over perennially frozen ground are the main mechanisms by which these features were constructed.

A minor ice readvance was responsible for a lake which flooded parts of the mound fields which had developed on the ground moraine. Six feet or more of stratified silts and clays cover the mounds which were under water. The ice tongue which caused this flooding was confined to the lower parts of the area. Glacial grooves impressed upon the clayey till which this ice tongue deposited reveal that there was marked topographic control of its movement.

The last Pleistocene event to leave an imprint on the area was an expansion of Cordilleran ice which sent a flood of coarse gravels down the valley of the Smoky River. Dissection of the valley train thus formed produced paired terraces along the sides of the preglacial section of the Smoky Valley. The terraces are believed to correlate with the Mankato glacial sub-stage. Thin deposits of alluvium, muck and peat deposited in Recent time are common.

Location: AE, QE 697. H496 1952
Areas: Map areas - 83 N
Borden areas - GQ
Topics: Geomorphology - terraces, Glacial chronology, Periglacial geomorphology - mounds, Quaternary stratigraphy, Till - lithology

Rhine, J.L.
1984 Sedimentological and Geomorphological Reconstruction of the Late Pleistocene Athabasca Fan-Delta, Northeast Alberta. Unpublished Masters thesis, Department of Geography, University of Calgary, Calgary, Alberta. (129 pp.)

Following Laurentide ice retreat in N.E. Alberta, approximately 10,000 years B.P., Glacial Lake McConnell (a high stand of Lake Athabasca) provided a shallow receiving basin and depocenter for the Athabasca River sediments. A braided, meso-energy, river-dominated delta prograded into this receiving basin and deposited a sedimentary sequence in subaqueous and subaerial deltaic environments which compare well with the fan-delta model. Basal lacustrine mud is overlain by interbedded lacustrine mud and offshore sand (5 meters), which in turn is overlain by a sequence of stacked trough crossbeds from a sandy braided river (15 meters). A braided river dominated this environment, although some evidence of wave influence is seen in the proximal area of the bottomset-bedded sand facies. Dip direction of trough indicates a predominantly northward paleocurrent flow direction.

The Late Pleistocene sand-dominated Athabasca Delta, mantled with a thin cover of aeolian sand, extends over an area of 4,200 km^2. The presence of stabilized elongate parabolic and longitudinal aeolian dunes indicates the Late Pleistocene occurrence of southeasterly high wind velocities on the delta plain. Large volumes of aeolian sand supplied to the Athabasca River are interpreted to account for the disproportionally large delta as compared to the modern delta.

This extensive deltaic deposit is exposed in river cutbanks along 100 km of the Athabasca River and 40 km of the Richardson River. Research on these exposures has resulted in the hypothesis that a massive influx of aeolian sand into the Athabasca River caused excessive bedload. This bedload material was deposited subsequently as a sandy fan-delta, dominated by braided fluvial processes, into Glacial Lake McConnell.

Location : ACU, UARC, ID#4252
ACU, Mic., QE 697. R45 1986
Areas : Map areas - 74 NW, 74 SW, 84 NE, 84 SE
Borden areas - IO, IP, HO, HP
Topics : Geomorphology - dunes, Glacial chronology, Glacial lake sequences, Sedimentology

g. Northeastern British Columbia

Leslie, L.E.

1988 Late Glacial Geology of the Finlay River Valley, British Columbia. Unpublished Masters thesis, Department of Geology, University of Alberta, Edmonton, Alberta. (109 pp.)

The landforms and deposits of the Finlay River Valley indicate the occurrence of major glacial activity in the past. The glacial landforms indicated on the surficial map of the area include drumlins, grooves, eskers, and meltwater channels. The surficial deposits are divided into Holocene and Pleistocene deposits. Holocene deposits include organic, alluvial, and fluvial units. Pleistocene deposits include glaciofluvial, glaciolacustrine, and morainal units.

Morainal units form approximately 95% of the surficial deposits, represented by four diamicton types: 1, 1A, 1B, and 2. Type 1 Diamicton is interpreted to be a subglacial till based on the massive texture, ordered fabric, and lack of sorted sediments. Type 1A Diamicton is a lodgment till based on fissility and a well ordered fabric. The coarse-textured diamicton and preserved sand and gravel lenses at and near the base of the unit show Type 1B Diamicton to be a modified subglacial meltout till. Type 2 diamicton is interpreted to represent debris flow deposits on the bases of locally variable fabric orientations, the occurrence of diamicton interstratified with sand and gravel sediments, and the geometry of the diamicton beds.

Distribution of glacial landforms, such as drumlins and grooves, origin of morainal deposits, and lack of supraglacial deposits suggest that a) glacial debris was mostly subglacially transported and deposited, b) glacial ice flowed into the Finlay River Valley from the east and west, and c) more ice entered the valley from the west compared to the east. Deglaciation of the valley was continuous. There are no moraines or glaciofluvial ice-contact deposits which suggest the occurrence of a glacial stand-still.

Fluvial deposits represented by floodplains and terraces form most of the Holocene deposits. Terraces, dating from 3440±60 to 5780±110 years BP, suggest that they are not related to the deglaciation of the valley. Hence, their formation was probably the result of climatic fluctuations.

Location : AEU, SPCOLL, Thesis 88-98
Areas : Map areas - British Columbia - Northeastern
Borden areas - region as above
Topics : Diamicton - fabric, Diamicton - lithology, Diamicton - physical properties, Geomorphology - terraces, Glacial chronology, Glacial geomorphology

PART 2. LATE QUATERNARY PALAEOENVIRONMENTS

a. General

MacDonald, G.M.

1984 Postglacial Plant Migration and Vegetation Development in the Western Canadian Boreal Forest. Unpublished Ph.D. dissertation, Department of Botany, University of Toronto, Toronto, Ontario. (261 pp.)

Sediment cores were obtained from nine small lakes located along a broad latitudinal transect extending from central Alberta to the middle Mackenzie River valley, Northwest Territories. The radiocarbon dated fossil pollen records from these cores provided data for the reconstruction of postglacial vegetation development in the western Canadian Boreal Forest. The results from this research were combined with information provided in previously published palaeobotanical studies from the western Canadian interior and Alaska to reconstruct postglacial plant migration patterns in western Canada. An extensive network of modern pollen surface samples from western Canada aided in the interpretation of the fossil pollen record.

The western Canadian Boreal Forest region was deglaciated by at least 11,000 to 10,500 BP and initially supported a sparse, herb dominated vegetation. Populus was the only arboreal species present during this period. This early vegetation was replaced by Picea forest in central Alberta and adjacent British Columbia at ~10,000 BP. In the western Northwest Territories, extensive Betula glandulosa tundra developed between 10,500 and 10,000 BP and was subsequently replaced by Picea forest at ~9000 to 8500 BP. Betula papyrifera, Pinus contorta, Pinus banksiana, and Alnus crispa appeared in the western Boreal Forest during the mid-Holocene.

Picea glauca, Picea mariana, Pinus contorta, Betula papyrifera and Alnus crispa appear to have migrated into the study area from southern refugia. Populus balsamifera and Betula glandulosa probably also expanded into the study area from glacial refugia in Beringia. Populus, Betula glandulosa and Picea spp. were able to reach their modern limits in the study area during the early Holocene. Betula papyrifera, Pinus contorta and Alnus crispa did not reach their modern distributions in the study area until the mid-Holocene.

This pattern of vegetation development was probably primarily controlled by the differential migration rates of plant species into the region following deglaciation, and by progressive edaphic development. The differential rates of migration of species into the study area appear explainable by differences in the seed production, seed dispersal and germination-maturation strategies of the various plant species considered. It is suggested that vegetation instability and development was generated during the early to mid-Holocene when plant communities established by fast migrating species were invaded by slower migrating, but competitively superior species.

Location : IC
Areas : Map areas - 74 P, 84 D, 94 H, British Columbia - Northeastern, Northwest Territories
Borden areas - IP, HQ, HR, regions as above
Topics : Modern pollen studies, Plant migration, Pollen analysis, Vegetation history - boreal forest

b. Southern Western Corridor

Bujak, C.A.

1974 Recent Palynology of Goat Lake and Lost Lake, Waterton Lakes National Park. Unpublished Masters thesis, Department of Geography, University of Calgary, Calgary, Alberta. (60 pp.)

Sediment cores were recovered from Goat and Lost Lakes in Waterton Lakes National Park, southwestern Alberta. Palynological analysis of samples (taken every one centimeter) along the length of two cores from each site was done to construct pollen diagrams which showed changes in relative percentages of each species. Carbon 14 dates on wood detritus near the base of the cores dated Goat Lake deposits at approximately 4610±440 years B.P. and Lost Lake sediments at just over 1630±160 years B.P.

The Recent pollen assemblages were interpreted to show vegetation history. This was done on the basis of a comparison of modern pollen rain and present vegetation pattern. Regional vegetation was over-represented in the pollen, and local vegetation under-represented. The vegetation study also suggested that Abies lasiocarpa and Picea engelmannii were co-dominant in the local climax subalpine vegetation.

Fossil pollen assemblages were correlated between cores with Carbon 14 dates. Pollen spectra were similar to that in the modern pollen rain throughout the lengths of the cores, and indicated the same species have been present both regionally and locally for about 4600 year. There was a small gradual increase in arboreal pollen at the expense of herbs and shrubs, as arboreal density and cover increased. Pinus contorta, dominant in all cores, was evidence of continued fire disturbance during the past 4600 years. Locally, Picea engelmannii and Abies lasiocarpa have always been present and co-dominant in climax subalpine communities.

The distribution of avalanche detritus in all cores indicated avalanching has been common. However, at approximately 1630 years B.P. there is an Alnus sp. peak associated with avalanche detritus. This was believed to have been caused by a cooler and more moist climate with increased snowfall and extensive avalanching. This period corresponds to the Audubon Neoglacial event, (Mahaney 1972), but further evidence is needed to document this climatic change.

Location : ACU, UARC, ID#1732
ACU, Mic., QE 993. B84 1974
Areas : Map areas - 82 G, 82 H
Borden areas - DP
Topics : Fire history, Lake cores, Neoglaciation, Plant macrofossils - wood, Pollen analysis, Vegetation history

Dove, J.E.

1981 Towards a Holocene Paleoecology of the Ghost River and Water Valley Areas, Southwestern Alberta. Unpublished Masters thesis, Department of Geography, University of Calgary, Calgary, Alberta. (152 pp.)

The aim of this research is to provide Holocene paleoecological information on the Ghost River and Water Valley areas in southwest Alberta. To this end a radiometrically dated core was examined for palynomorphs from a bog near Winchell Lake, 7.5 km south of the small town of Water Valley. In addition, a section from the shore of an "un-named" lake at latitude 51°18'N and longitude 115°05'W in the Ghost River area was analyzed for

Mollusca, Ostracoda, grain size, carbonate, and organic matter content.

The core taken from near Winchell Lake failed to show changes in pollen composition to mark the end of the warm interval known as the Altithermal (Antevs, 1948). The failure of the core to show changes is attributable to the influence of microclimate on the local vegetation in an east-west trending coulee which obscured the regional pollen trends.

Based on changes in faunas and sediments, it is suggested that the "unnamed" lake section was produced under two different depositional environments. These are a lacustrine sequence which is terminated by a buried soil and overlain by an aeolian sequence. The zonation of the section is supported statistically using the Kolmogorov-Smirnov significance test and cluster analysis.

Possible factors responsible for the changes as seen in the section include natural drainage and infilling of the lake, climatic fluctuation, differential erosion of the outlet, and alluvial fans that occur to the north and east of the lake. The lake may have occupied an enclosed basin for a period or periods of time during the early Holocene, prior to eventual drainage and exposure of the lacustrine sequence to soils development.

A number of changes within the section are tentatively related to Holocene climatic change. The low faunal content of zone I is correlated with a cold, dry tundra-like environment associated with deglaciation. The increase in carbonate and faunal content in zone II is equated with warmer, wetter conditions associated with the establishment of coniferous forests in the palynological record. A short lived deterioration in climate may be indicated in subzone IIc. The reduced faunas in subzones IIIa, IIIb, IIIc is correlated with warmer, conditions of the Altithermal. An increase in precipitation after the deposition of the tentatively identified Mazama Tephra may have led to the rapid drainage of the lake so that the lacustrine sequence became exposed at the end of subzone IIId. Continued drainage of the site allowed for the development of a soil on the exposed lacustrine sequence which was subsequently buried by loess. Somewhat cooler, more moist conditions causing somewhat more stable lake levels and or a decline in fire frequency could have aided in the development of the soil and the darker horizon noted within the aeolian sequence. The subsequent loess deposition appears to have been continuous, although depositional rates may have changed in response to Neoglacial events.

Location : ACU, UARC, ID#3384
ACU, Mic., QE 720. D68 1983
Areas : Map areas - 82 O
Borden areas - EP
Topics : Lake cores, Loess, Molluscs, Ostracods, Pollen analysis, Sediments - physical properties, Tephra - Mazama

Driver, J.C.

1978 Holocene Man and Environments in the Crowsnest Pass, Alberta. Unpublished Ph.D. dissertation, Department of Archaeology, University of Calgary, Calgary, Alberta. (230 pp.)

This study considers the prehistory of the Crowsnest Pass, in the Northern Rocky Mountains, from an economic standpoint. It is argued that, by understanding the relationship between prehistoric human groups and their environments, greater insights into other aspects of culture and society can be obtained.

The relationship between human groups and environment can be ascertained by studying prehistoric environments, food procurement activities, and site location.

The modern environments of the Crowsnest Pass include grasslands, forests and alpine vegetation in a varied topography. Palynology and pedology show that these three zones have existed in the Pass since at least 10,000 B.P. Periods of grassland expansion occurred at 7500 to 5500 B.P., and 4000 to 3000 B.P. Periods of forest expansion were c. 10,000 B.P., 5500 to 4000 B.P., and 3000 B.P. to the present. Changes in vegetation can be correlated with changes taking place in other areas of the Rockies.

Human groups have occupied the Pass since at least 10,000 B.P. Local subphases of the Southern Alberta sequence can be defined for the Pass, and relationships with surrounding areas can be documented from artifact styles and lithic raw material distribution.

Analysis of faunal remains and site location shows that the seasonal round of prehistoric groups in the Pass was based upon ungulate hunting. Different areas of the Crowsnest Pass were occupied at different seasons in response to behavioral changes in ungulate populations. Bison were the dominant food source during late fall, winter and early spring. At other times of year, a wider resources base was utilised. This pattern can be traced back for at least 8000 years.

Environmental change in the Crowsnest Pass had little discernable effects upon human groups, because the three major vegetation zones were always present. As environmental zonal boundaries changed, animal populations may have fluctuated, but basic seasonal patterns remained the same for animals and man.

Location : ACU, UARC, ID#0086
ACU, Mic., E 78. A33 D74 1978
Areas : Map areas - 82 G
Borden areas - DP
Topics : Archaeology, Faunal remains, Lake cores, Pollen analysis, Vegetation history

c. Central Western Corridor

Beaudoin, A.B.

1984 Holocene Environmental Change in the Sunwapta Pass Area, Jasper National Park. Unpublished Ph.D. dissertation, Department of Geography, University of Western Ontario, London, Ontario. (487 pp.)

The Sunwapta Pass area contains environmental records extending back to the late glacial/early Holocene. The records obtained by pollen analysis of one alpine and five subalpine sites were examined to establish if a consistent pattern of environmental change occurred.

Chronologic control was provided by radiocarbon dates and tephrostratigraphy. The oldest date, 9600±305 (GX-8785), came from near the base of the alpine Wilcox Pass Core. Tephra identification, using titanomagnetite composition determined by electron probe microanalysis, was hampered by the difficulty of distinguishing analytically between Mazama and Bridge River tephras. Characterization based on differences in glass shard morphology was useful in this case.

The alpine site provided the most complete regional environmental record. The basal zone (WP1), dominated by Artemisia pollen, represented the initial vegetation after deglaciation and is the earliest assemblage yet described from this area of the middle Canadian Rockies. In Zone WP2, a lodgepole pine forest was present. Small amounts of Arceuthobium pollen indicated a probable higher-than-present treeline. Zone WP3 contained substantial amounts of haploxylon (whitebark) pine. Increasing Picea and Abies pollen implied that subalpine forest was now established. This has persisted to the present (Zones WP4 and WP5). The Hypsithermal is not well-marked. Picea/Pinus ratios, by comparison with contemporary pollen samples, showed timberline higher-than-present for most of the Holocene with a substantial retreat beginning c. 1800 yr B.P. marking the onset of Neoglacial conditions.

In contrast to this continuous record, subalpine bogs from the Sunwapta Pass valley floor were greatly influenced by episodic sedimentation from large alluvial fans. However, three records extended to the early Holocene. In general, the records showed a similar pattern to that from Wilcox Pass. Abundant charcoal in all records indicate that fire has been an important environmental influence throughout the Holocene. The incomplete and equivocal environmental history provided by the subalpine bogs in Sunwapta Pass emphasises the role of the data from relatively undisturbed alpine sites as a basis for calibration and comparison.

Location : IC
Areas : Map areas - 83 C
Borden areas - FQ
Topics : Bog cores, Charcoal - fire history, Holocene timberline fluctuations, Pollen analysis, Tephra - Bridge River, Tephra - Mazama, Tephra - St. Helens, Vegetation history

Bombin, E.R.

1982 Holocene Paleolimnology of Mary Gregg Lake, Foothills of the Alberta Rocky Mountains. Unpublished Masters thesis, Department of Botany, University of Alberta, Edmonton, Alberta. (147 pp.)

Two cores from Mary Gregg Lake (0.08 km^2, 53°7'N, 117°28'W, and 1540 m a.s.l.) were submitted to a multi-variable analysis (stratigraphy, sedimentology, geochemistry, and micropaleontology), aiming at the reconstruction of its Holocene paleoecological evolution within the context of the surrounding area.

Radiocarbon dates corrected for contamination suggest that the available record spans approximately the last 6000 years. During this period the watershed has been dominantly covered by boreal forest, although more open forest and mesic conditions are indicated before ca. 3500 BP.

Many of the analyzed variables show a similar stratigraphic pattern, the sample data being structured in three basic clusters (zones). They suggest that: between ca. 6000±200 and 3500±200 BP the lake was relatively more eutrophic and supported higher productivity; between 3500±200 and 1000±200 BP, the conditions were more oligotrophic, and the productivity was at its minimum; and after 1000±200 BP, the aquatic system returned to its predominantly mesotrophic state of today.

It is suggested that the cause of these changes is a combination of environmental oscillations and geomorphic conditioning (the lake is located at the water divide of the valley, which limits its volume to a certain maximum). It is hypothesized that the predominance of a longer ice-free season could produce the effects observed before ca. 3500 BP; while a shorter ice-free season (colder?) and possibly wetter conditions could be related to the status between 3500±200 and 1000±200 BP. An intermediate situation seems to be dominant in the last 1000±200 years. Human impact has not been a major cause of change in this wilderness area, so far; however, future coal mining operations are scheduled for the vicinity of the lake.

Location : AEU, SPCOLL, Thesis 82-11
Areas : Map areas - 83 F
Borden areas - FQ
Topics : Diatoms, Lake cores, Palaeolimnology, Pollen analysis, Sediments - chemistry

Holland, D.K.

1980 The Pollen Stratigraphy of Two Holocene Sections in Sunwapta Pass, Jasper National Park, Alberta. Unpublished Masters thesis, Department of Geography, University of Western Ontario, London, Ontario. (105 pp.)

A study of Holocene vegetation and climatic history was undertaken with samples collected from two sections and surface samples in the area of Sunwapta Pass, Jasper National Park, Alberta. The two sections SP1 and SP9 were from two basins on the edge of large alluvial fans and were analyzed for pollen, macrofossils, charcoal, volcanic ash and sediment stratigraphy.

The stratigraphy of the sections consist of clastic and peat layers, resting on grey lacustrine clay which is believed to represent proglacial lake conditions. Chronologic control is provided by three volcanic ashes and radiocarbon dates. The three distinct volcanic ash layers were identified by morphologic examination of their glass shards as Mazama, St. Helens Y and Bridge River ashes. Wood fragments from a nearby site yielded a radiocarbon date of 8100 ± 100 yr. B.P. (G.S.C. 2589) which provides a minimum date for deglaciation of the pass.

All of the pollen diagrams were dominated by Pinus pollen, much of which was thought to be from extraregional sources. The pollen found at the sites was thought to be the result of both atmospheric rain and advected pollen by streams flowing from the alluvial fans bringing in pollen from the alpine meadow. Some fluctuations in the pollen records may be the result of stream migration on the alluvial fan which change the relative dominance from local to regional pollen influx. The presence of charcoal microfragments and macrofragments indicate a prolonged fire history extending from deglaciation to the present.

Evidence from the pollen and sediment stratigraphy suggest that the paleoclimate follows a threefold Late Glacial/Hypsithermal/Neoglacial sequence.

Location : IC
Areas : Map areas - 83 C
Borden areas - FQ
Topics : Charcoal - fire history, Glacial chronology, Pollen analysis, Tephra - Bridge River, Tephra - Mazama, Tephra - St. Helens, Vegetation history

Kearney, M.S.
1981 Late Quaternary Vegetational and Environmental History of Jasper National Park, Alberta. Unpublished Ph.D. dissertation, Department of Geography, University of Western Ontario, London, Ontario. (318 pp.)

This study examines the Late Quaternary vegetational and environmental history of Jasper National Park, Alberta. The record of vegetational/ environmental change in this area is compared to those of other sites in the Western Cordillera.

Selected aspects of the modern vegetation of Jasper National Park were investigated to aid interpretation of the palynological record. Examination of the dynamics of the modern timberline at several sites demonstrated that seedling establishment at timberline is significantly correlated with higher than average mean minimum summer temperatures. Investigation of the characteristics of the modern pollen rain along two altitudinal transects showed that the three major biome types, the alpine tundra, the subalpine forest, and the montane forest, have distinctive signatures in the contemporary pollen spectra. Regression equations of changes of several arboreal pollen ratios with elevation were derived to refine the reconstruction of ecotone boundary fluctuations in the fossil record. Of the ratios tested, Abies/Pinus ratios were found to be the most successful in delineating past timberline changes.

Palynological investigations of five sites spanning a broad spectrum of environments and elevations provide a consistent picture of postglacial environmental change in Jasper National Park. The earliest available record (c. 9700 yr BP) is from a subalpine site (Tonquin Creek), and depicts a Pinus contorta forest which suggests warmer conditions. The succeeding zone (c. 9000-8000 yr BP) was characterized by a mosaic of Pinus albicaulis-Abies lasiocarpa-Picea engelmannii, implying cooler conditions than at present.

The last c. 8500-8000 years are covered by the pollen records of all sites. The Hypsithermal Interval in this area is dated c. 8500-5900 yr BP, and was characterized by major advances of timberlines and widespread desiccation of meadows and fens at lower elevations. Comparative evidence from the sites suggests that the Hypsithermal was complex, with two major warm phases punctuated by a cool episode between c. 8000-7500 yr BP. The warmest phase (c. 7500-5900 yr BP) culminated shortly before c. 6600 yr BP, and was perhaps drier than the earlier phase (c. 8500-8000 yr BP).

After c. 5900 yr BP, the sharp retreat in timberline recorded in the alpine sites and indications of expansion of wet areas at the other sites suggest the onset of cooler, moister conditions associated with Neoglaciation. The timberline record indicates that summer temperatures were similar overall to the present c. 5900-1610 yr BP. Since c. 1700-1610 yr BP, depending on the resolution afforded by individual sites, climates appear to have become cooler as suggested by the continued retreat of the timberline and the increased representation of arctic-alpine taxa in all upper elevation sites. The last c. 500 years, characterized by the lowest timberlines in the record, have witnessed particularly severe climates.

Although cool, moist conditions have generally prevailed during the Neoglacial, synthesis of the available pollen records indicates that this period has been marked by several warmer episodes: c. 4870 yr BP, 4110-2950 yr BP, 1060 yr BP, and 520 yr BP. Oxygen isotope and mollusc evidence from an upper montane forest site (Maligne Lake) suggest that the prolonged episode c. 4110-2950 yr BP may have been as much as 2-3°C warmer than present.

Location : IC
Areas : Map areas - 83 SW
Borden areas - FQ
Topics : Charcoal - fire history, Holocene timberline fluctuations, Modern pollen studies, Molluscs, Neoglaciation, Oxygen isotope studies, Pollen analysis, Vegetation history

MacDonald, G.M.

1980 The Post-glacial Paleoecology of the Morley Flats and Kananaskis Valley Region, Southwestern Alberta. Unpublished Masters thesis, Department of Geography, University of Calgary, Calgary, Alberta. (78 pp.)

Quaternary paleoecological data is still relatively scarce for southwestern Alberta. Accordingly, the objective of this research is to provide information on the post-glacial paleoenvironmental history of the Morley Flats and Kananaskis Valley region of southwestern Alberta. In pursuit of this goal, a radiometrically and tephrachronologically dated core from a small bog near the Yamnuska Centre on the Morley Flats and a radiometrically and tephrachronologically dated lacustrine sediment section from Wedge Lake in the Kananaskis Valley are examined in terms of several paleoecological parameters.

Sediment grain size distribution and carbonate content are assessed to provide details of the depositional history for each study site. Palynological analysis is utilized to reconstruct the vegetational history of the region. Fossil molluscan faunal analysis is employed to provide data on environmental variation in the aquatic environment of each study site. In addition, a number of descriptive, preliminary, bivariate and multi-variate statistical techniques are examined in terms of their applicability to the paleoecological data.

The empirical interpretation of the results of this research provides a detailed assessment of the post-glacial paleoenvironmental history of the study site. Immediately following deglaciation of the Morley Flats, a tundra-like vegetation was able to colonize the cold and dry regions. By at least 10,400±110 B.P. (GSC-2965) the major portion of the Kananaskis Valley, including Wedge Lake, was ice-free and coniferous forests were establishing themselves in the area. A significant trend of climatic amelioration continued from this period until shortly after the deposition of a pyroclastic layer which is tentatively identified as Mazama tephra. This period of warm and dry conditions was interrupted once by an episode of climatic deterioration which occurred after 9395±215 B.P. (GX-6767) and prior to 6600 B.P. Following the deposition of the tephra layer, conditions deteriorated significantly. This episode was followed by a period of renewed climatic amelioration. By 1140±70 B.P. (Beta-1282) cool and moist conditions again became prevalent.

Location : ACU, UARC, ID#3212
ACU, Mic., QE 720. M16 1980
Areas : Map areas - 82 J, 82 O
Borden areas - EP

Topics: Bog cores, Molluscs, Pollen analysis, Sediments - chemistry, Tephra - Mazama, Vegetation history

Reasoner, M.A.

1988 The Late Quaternary Lacustrine Record from the Upper Cataract Brook Valley, Yoho National Park, British Columbia. Unpublished Masters thesis, Department of Geology, University of Alberta, Edmonton, Alberta. (201 pp.)

Three lakes in the upper Cataract Brook Valley - Lake O'Hara, Mary Lake, and Opabin Lake - are situated directly adjacent to a high section of the Continental Divide in the central Canadian Rocky Mountains. A total of 30 cores were recovered from the lakes using a lightweight percussion coring system designed for winter use in remote areas. The cores show a consistent stratigraphy comprising tephra bearing gyttja and underlying clastic lacustrine sediments. The identification of Bridge River (2350 years BP) and Mazama (6800 years BP) tephras was confirmed by electron microprobe analysis of the constituent glass shards. Radiocarbon dates obtained from conifer needles (extracted from lowermost sediments) indicate that deglaciation had proceeded upvalley from the O'Hara basin prior to *ca.* 10,100 years BP. Highly variable sedimentation rates in the Lake O'Hara records suggest that the use of this data as a proxy record of upvalley glacial activity is inappropriate in Lake O'Hara, which is not directly fed from a glacial source. Higher total sedimentation rates in post-Bridge River Opabin Lake cores are related to climatic conditions associated with more extensive upvalley ice. Increasing downcore trends in the aspartic acid D/L ratios suggest that amino acid data from bulk gyttja samples may be used as a check for reworking in cases where chronostratigraphic markers are absent.

The post-glacial colonizing vegetation prior to *ca.* 10,100 years BP at Lake O'Hara and before *ca.* 8530 years BP at Opabin Lake was a shrub herb community dominated by *Artemisia*, Gramineae and *Alnus*. Pioneering forests at both sites were composed of *Pinus* cf. *albicaulis/flexilis* and *Abies* with lesser abundances of *Picea* and *Pinus* cf. *contorta*. timberline remained above the elevation of Opabin Lake for the period *ca.* 8500 years BP to *ca.* 3000 years BP in response to warmer climatic conditions associated with restricted glacial activity. Forest compositions resembling the modern subalpine *Picea*-*Abies* forest had developed by the end of this period. The period *ca.* 3000 years BP to present was marked by deteriorating climatic conditions associated with renewed glacial activity in the Opabin Cirque and declining timberlines to below the elevation of Opabin Lake.

Location: AEU, SPCOLL, Thesis 88-152
Areas: Map areas - British Columbia - Yoho National Park
Borden areas - region as above
Topics: Amino acid dating, Glacial chronology, Holocene timberline fluctuations, Lake cores, Plant macrofossils - needles, Pollen analysis, Tephra - Bridge River, Tephra - Mazama, Vegetation history

d. Northern Western Corridor

White, J.M.

1983 Late Quaternary Chronology and Palaeoecology of the Upper Peace River District, Canada. Unpublished Ph.D. dissertation, Department of Archaeology, Simon Fraser University, Burnaby, British Columbia. (149 pp.)

Pollen percentage and influx analyses and radiometric dating of sediment cores from three lakes in the Peace River district of northeastern British Columbia and northwestern Alberta were used to investigate the regional Late Quaternary geochronology and palaeoecology. Microfossil and macrofossil analyses of a basal core segment from Boone Lake showed that two ^{14}C ages greater than 12,000 years B.P. were spuriously old due to Cretaceous age organic contamination. The sedimentary record began in Boone Lake about 12,000 years B.P. during deglaciation, and sedges dominated a diverse aquatic and upland vegetation close to receding ice. A poplar-willow-sage-grass-sedge zone occurred probably prior to 11,600 years B.P., indicating a humanly habitable "Ice-free Corridor" in the Saddle Hills. A major poplar decline took place at about 10,800 years B.P., probably because of increasing competition from conifers. The forest was similar to modern boreal coniferous forest with more abundant shrubs and herbs. It is considered unlikely that spruce could have migrated from the central prairies to Beringia by 11,500 years B.P. without becoming established in the Peace River area prior to 10,400 years B.P. The regional pine presence at 10,400 years B.P. sets a minimum age for the withdrawal of Glacial Lake Peace to the Indian Creek Stage, and for the cessation of regional periglacial activity. A possible minor climatic regression took place about 10,000 years B.P. Tree birch became an important forest element between 8700 and 8200 years B.P., followed by a pine peak at 7400 years B.P. which is interpreted as the Hypsithermal maximum. No significant expansion of the Peace River grasslands took place during the Hypsithermal. A trend to wetter conditions began around 7400 years B.P., with the establishment of some permanent ponds by about 5100 years B.P. A minor spruce decline and alder increase has taken place in the last 3400 years. The application of a non-parametric statistical technique is proposed as a test for randomness of distribution of uncommon pollen types.

Location : IC
Areas : Map areas - 83 M
Borden areas - GQ
Topics : Analysis of radiocarbon dates, Glacial lake sequences, Ice-free corridor, Insect studies, Lake cores, Molluscs, Ostracods, Plant macrofossils - Bryophytes, Plant macrofossils - seeds, Pollen analysis, Vegetation history

e. Central and East-Central Alberta

Holloway, R.G.

1978 Absolute Pollen Influx and Paleoenvironmental Interpretations from Lake Wabamun, Alberta, Canada. Unpublished Masters thesis, Texas A. & M. University, College Station, Texas. (91 pp.)

A 15.5M sediment core was obtained from Lake Wabamun, Alberta, Canada. Absolute pollen frequencies were calculated instead of the usual relative pollen frequencies which allowed for a more nearly accurate investigation of changes in the fossil pollen record.

Modern pollen rain samples were analyzed and used in the identification of the fossil pollen record. In addition, samples were also analyzed for loss on ignition as well as pollen content in Paleocene lignite deposits from the area. Eleven radiocarbon dates were obtained and yielded a basal date of 16,180 years B.P. The eleven dates were all internally consistent. These above data, in conjunction with geologic and soils evidence indicated a probable stable vegetational, and by implication, climatic history for this region.

Location : ILL, Texas A. & M. University
Areas : Map areas - 83 G
Borden areas - FP
Topics : Lake cores, Pollen analysis, Tephra - Mazama, Vegetation history

PART 3. LATE QUATERNARY PALAEONTOLOGY

a. General

Reimchen, T.H.F.

1968 Pleistocene Mammals from the Saskatchewan Gravels in Alberta. Unpublished Masters thesis, Department of Geology, University of Alberta, Edmonton, Alberta. (99 pp.)

This paper presents the results of a paleontologic and stratigraphic study of the Saskatchewan gravels in Alberta, Canada. These stratified fluvial sediments, composed largely of quartzose pebbles, were deposited before the advance of the Laurentide ice into central and southern Alberta. The most common fossils recovered are remains of horses, referred to Equus cf. niobrarensis Hay. Other fossils identified and described are referred to Bison sp., Camelops sp., Titanotylopus sp., Antilocapra sp., Citellus sp., and Mammuthus cf. columbi Falconer.

In North America the presently known temporal distribution of Equus niobrarensis Hay is Kansan to Wisconsin; Illinoian to recent for Bison; Nebraskan to Wisconsin for Camelops; Late Pliocene to Yarmouth for Titanotylopus; Wisconsin to Recent for Antilocapra; Pliocene to Recent for Citellus; and ?Sangamon to Wisconsin for Mammuthus columbi Falconer.

The presence of Bison and Antilocapra in the younger (lower) levels of the Saskatchewan gravels in parts of central and southern Alberta demonstrates that these deposits may be properly assigned to the Rancholabrean Provincial Age.

The remains of Antilocapra in the low-level (youngest) Saskatchewan gravels in southeastern Alberta indicate that the maximum age for the overlying glacial drift here is Wisconsin. Similarly the presence of Bison in the low-level Saskatchewan gravels in central Alberta indicates that the maximum possible age for overlying glacial drift in this region is Illinoian.

Location : AEU, SPCOLL, Thesis 1968-92
Areas : Map areas - All Alberta
Borden areas - All Alberta
Topics : Faunal remains - Bison, Faunal remains - Equus, Faunal remains - Camelops, Faunal remains - Antilocapra, Faunal remains - Mammuthus, Faunal remains - Citellus, Faunal remains - Titanotylopus, Quaternary stratigraphy - Saskatchewan gravels and sands

b. Southern Western Corridor

Brulotte, R.K.

1983 Zooarchaeological Interpretation of Two Sites in Southwestern Alberta. Unpublished Masters thesis, Department of Anthropology, University of Alberta, Edmonton, Alberta. (139 pp.)

Archaeological investigations at two sites in the Canadian Rocky Mountains of southwestern Alberta provided the data for analysis. The thesis describes various theoretical and methodological problems involved in habitat interpretation and reconstruction at these sites.

It is suggested by the small mammal data that application of macro-biological theories (Zonation Hypothesis) to interpret specific zooarchaeological sites can be erroneous. Diversity in habitats at particular sites can be explained better through mosaic hypotheses.

Taphonomic interpretations also indicated various causes of mixed assemblages in zooarchaeological sites. The natural interaction of each represented species in its particular and changing habitat must be addressed. In this respect MNIs are of limited use to archaeologists; the particular number of species present and their relationship indicates more closely the habitats in prehistoric times.

Analysed cultural data hint at a north-south rather than an east-west trans-mountain affiliation among prehistoric populations in the research area. Artifact functions and social activities at the sites are only inferred on a general scale; their relationships to the habitats in question are minimally known.

Note : Three radiocarbon dates are available from the Racehorse Rockshelter: 3050±130 years BP from Level 5 (in thesis) together with 4425±235 years BP (S-2418) from Level 6, and 8775±365 years BP (S-2417) from Levels 16 and 17 (Brulotte, pers. comm. to J.A. Burns, 1984).

Location : AEU, SPCOLL, Thesis 83F-28

Areas : Map areas - 82 G
Borden areas - DP

Topics : Archaeological sites - DlPo-4, Archaeological sites - DkPp-11, Artifacts, Cave deposits, Faunal remains

Burns, J.A.

1984 Late Quaternary Palaeoecology and Zoogeography of Southwestern Alberta: Vertebrate and Palynological Evidence from Two Rocky Mountain Caves. Unpublished Ph.D. dissertation, University of Toronto, Toronto, Ontario.

Knowledge of the environment and zoogeography of the Late Wisconsin is augmented by recoveries in the Rocky Mountains of southwestern Alberta from January Cave on Plateau Mountain and from Eagle Cave in the Crowsnest Pass. The cave excavations, originally undertaken in the pursuit of early man in North America, revealed thousands of bones and teeth of Pleistocene and Holocene microvertebrates. A taphonomic enquiry suggests that the January Cave remains were deposited largely by avian raptors but also by mammalian carnivores, and not by fluvial or glacial action. The bones and teeth identified include at least 54 species of mammals, 23 species of birds, and four species of fish, dating back 23,000 years or more. Complementary to the faunal analysis, the study of fossil pollen in sediments at January Cave serves to confirm that locally, and probably regionally, there was ice-free terrain around Plateau mountain in the Late Wisconsin. Treeless tundra formed a backdrop to the activities of animals of which the indigenous horse and passenger pigeon are now extinct and some of which now have dramatically different ranges including two lemmings, prairie dogs, ferrets, swift fox, and Arctic grayling. The nature of Pleistocene glaciations makes it difficult, however, to synthesize Wisconsin-age environments and biogeography in Alberta because few substantial sites in primary context are known.

Note : New radiocarbon dates of 31,900±1400 years BP (QL-1738) and 33,500±1100 years BP (QL-1737) have been obtained from this site (J.A. Burns, pers. comm., 1988).
Location : IC
Areas : Map areas - 82 G, 82 J
Borden areas - DP, EP
Topics : Cave deposits, Faunal remains, Pollen analysis

c. Central and East-Central Alberta

Hillerud, J.M.

1966 The Duffield Site and its Fossil Bison, Alberta, Canada. Unpublished Masters thesis, University of Nebraska, Lincoln, Nebraska. (198 pp.)

This paper presents the results of a paleontologic and stratigraphic study of a vertebrate fossil site near Duffield, Alberta. Remains of Bison occidentalis Lucas, 1898 are found weathering from a marl and peat deposit exposed on the North Saskatchewan River. Fourteen specimens of skulls and skull fragments, seven of them nearly complete, were studied; the measurement data on seven male specimens and photographs of nine specimens are presented. The hypothesis of an ephemeral, flood-plain lake evolving to a bog deposit is considered to be the origin of the site.

Remarks on the status of infraspecific taxa are presented; genetical, ecological and mensuration evidence from the study of bison populations indicates that, in the absence of a demonstrable reproductive barrier, synchronous populations may be considered to have subspecific relationships. This conclusion is applied to the synchronous population of Bison antiquus (Leidy) 1852 and Bison occidentalis, and the latter species is classified as a subspecies Bison antiquus occidentalis Lucas.

Location : AEA, HSS/ASA, 917.123303 H557d
Areas : Map areas - 83 G
Borden areas - FP
Topics : Archaeological sites - FiPn-18, Faunal remains - Bison

SECTION D. CONFERENCE ABSTRACTS

PART 1. LATE QUATERNARY GEOLOGY

a. General

Osborn, G., and P.T. Davis

1985 Age of Pre-Altithermal Cirque Moraines in the American and Southern Canadian Cordillera. CANQUA Symposium on the Paleoenvironmental Reconstruction of the Late Wisconsin Deglaciation and the Holocene, Lethbridge, Program-with-Abstracts and Field Guide, 50.

Location : IC
Areas : Map areas - 82 G, 82 H, 82 J, 82 N, 82 O, 83 SW, British Columbia - Eastern, United States - Northern Rockies, United States - Southern Rockies
Borden areas - DP, EP, EQ, FQ, regions as above
Topics : Glacial chronology

Reeves, B.O.K.

1985 The Ice Free Corridor: A Historical Perspective. CANQUA Symposium on the Paleoenvironmental Reconstruction of the Late Wisconsin deglaciation and the Holocene, Lethbridge, Program-with-Abstracts and Field Guide, 53.

Location : IC
Areas : Map areas - All Alberta
Borden areas - All Alberta
Topics : Glacial chronology, Ice-free corridor

Rutter, N.W.

1982 Pleistocene History of the Western Canadian Ice-Free Corridor. GAC/MAC Joint Annual Meeting Program with Abstracts 7:78.

Location : ILL, OOG
Areas : Map areas - All Alberta, British Columbia - Northeastern
Borden areas - All Alberta, region as above
Topics : Glacial chronology, Ice-free corridor, Quaternary stratigraphy

Rutter, N.W.

1978 Geology of the Ice-Free Corridor. AMQUA, 5th Biennial Meeting, Edmonton, Alberta, Abstracts, 2-12.

Location : AEU, SCI, QE 696. A52
AEPAA, 551.79 AM35
Areas : Map areas - All Alberta, British Columbia - Northeastern
Borden areas - All Alberta, region as above
Topics : Glacial chronology, Ice-free corridor

Stalker, A. MacS.
1970 Late Wisconsin Glaciation and the Yukon-Alberta Ice-Free Corridor. AMQUA, 1st Biennial Meeting, Abstracts, 126.

Location : AEU, SCI, QE 696. A52 1970
Areas : Map areas - All Alberta
Borden areas - All Alberta
Topics : Glacial chronology, Ice-free corridor

b. Southern Western Corridor

Alley, N.F.

1971 Pleistocene Ice Movements and Glacial Limits West of the Porcupine Hills, Southwestern Alberta. Geological Society of America Abstracts with Programs 3(6):365-366.

Location : AEU, SCI, QE 1. G34 A1
Areas : Map areas - 82 G, 82 H
Borden areas - DP
Topics : Glacial chronology, Glacial lake sequences, Quaternary stratigraphy

Barendregt, R.W. and A. MacS. Stalker

1985 A Model of Moraine Emplacement in the Western Great Plains of North America. CANQUA Symposium on the Paleoenvironmental Reconstruction of the Late Wisconsin Deglaciation and the Holocene, Program-with-Abstracts and Field Guide, 16.

Location : IC
Areas : Map areas - 82 H
Borden areas - DP
Topics : Glacial geomorphology - "ice-pressed" features, Glacial geomorphology - moraines

Day, D.L.

1971 Quaternary Deposits in the Trout Creek Drainage Area, Porcupine Hills, Southwestern Alberta. Geological Society of America Abstracts with Programs 3(6):377.

Location : AEU, SCI, QE 1. G34 A1
Areas : Map areas - 82 G, 82 H, 82 I, 82 J
Borden areas - DP, EP
Topics : Erratics Train, Glacial lake sequences, Quaternary stratigraphy, Tephra, Till - heavy minerals, Till - physical properties

Eschman, D.F.

1970 A Minimum Age for Maximum Wisconsin Ice, Southwestern Alberta. AMQUA, 1st Biennial Meeting, Abstracts, 40.

Location : AEU, SCI, QE 696. A52 1970
Areas : Map areas - 82 G, 82 H
Borden areas - DP
Topics : Glacial chronology, Glacial lake sequences

Hawes, R.J.

1978 Glacial History of the Kananaskis Valley, Rocky Mountain Front Ranges, Southern Alberta. AMQUA, 5th Biennial Meeting, Edmonton, Alberta, Abstracts, 208-209.

Location : AEU, SCI, QE 696. A52
AEPAA, 551.79 AM35
Areas : Map areas - 82 J, 82 O
Borden areas - EP
Topics : Glacial chronology

Karlstrom, E.T.

1985 Quaternary Glacial and Pedological History of Glacier-Waterton Park Area, Southwestern Alberta and Northwestern Montana. CANQUA Symposium on the Paleoenvironmental Reconstruction of the Late Wisconsin Deglaciation and the Holocene, Lethbridge, Program-with-Abstracts and Field Guide, 32-33.

Location : IC
Areas : Map areas - 82 G, 82 H, Montana - Glacier National Park
Borden areas - DP, region as above
Topics : Glacial chronology, Palaeosols, Soil - pedogenesis

Karlstrom, E.T.

1984 Late Quaternary Glacial and Pedological History, Glacier-Waterton Parks, International Boundary Area. Geological Society of America, Abstracts with Programs 16:226.

Location : AEU, SCI, QE 1. G34 A1
Areas : Map areas - 82 H, Montana - Glacier National Park
Borden areas - DP, region as above
Topics : Glacial chronology, Palaeosols, Soil - pedogenesis

Karlstrom, E.T.

1982 Stratigraphy and Genesis of Soils in "Kennedy Drift", Mokowan Butte, Southwestern Alberta. Geological Society of America, Abstracts with Programs 14:316.

Location : AEU, SCI, QE 1. G34 A1
Areas : Map areas - 82 H
Borden areas - DP
Topics : Palaeosols, Soil - pedogenesis

Karlstrom, E.T.

1982 Late Quaternary Glacial and Pedological History, Glacier-Waterton Parks, International Boundary Area. AMQUA, 7th Biennial Meeting, Seattle, Washington, Program and Abstracts, 112.

Location : AEU, SCI, QE 696. A52
Areas : Map areas - 82 H, Montana - Glacier National Park
Borden areas - DP, region as above
Topics : Glacial chronology, Palaeosols, Soil - pedogenesis

Kulig, J.J., and I. Shetsen

1986 The Effect of Provenance and Facies on the Grain Size Distribution of Glacial Diamictons in an Area of Mixed Bedrock Lithologies. GAC/MAC/CGU Joint Annual Meeting, Ottawa, Program with Abstracts 11:91-92.

Location : IC
Areas : Map areas - 72 E, 72 L, 72 M, 82 H, 82 I, 82 J, 82 P, 82 O
Borden areas - DO, DP, EO, EP
Topics : Diamicton - physical properties, Facies studies

Jackson, Jr., L.E.

1978 Quaternary Stratigraphy and History of the Alberta Portion of the Kananaskis Lakes 1:250,000 Sheet (82J) and its Implications for the Existence of an Ice-Free Corridor During Wisconsin Time. AMQUA, 5th Biennial Meeting, Edmonton, Alberta, Abstracts, 13-15.

Location : AEU, SCI, QE 696. A52
AEPAA, 551.79 AM35
Areas : Map areas - 82 J
Borden areas - EP
Topics : Analysis of radiocarbon dates, Erratics Train, Glacial chronology, Glacial lake sequences, Ice-free corridor, Quaternary stratigraphy

Osborn, G.

1984 Holocene Tephrostratigraphy and Glacial Fluctuations in the Waterton-Glacier Area, Alberta and Montana. Geological Society of America Abstracts with Programs 16:614.

Location : AEU, SCI, QE 1. G34 A1
Areas : Map areas - 82 G, 82 H, Montana - Glacier National Park
Borden areas - DP, region as above
Topics : Glacial chronology, Glacial geomorphology - moraines, Tephra - Mazama

Proudfoot, D.N.
1985 Late Wisconsinan Deglaciation Sediment Sequences in Southern Alberta. CANQUA Symposium on the Paleoenvironmental Reconstruction of the Late Wisconsin Deglaciation and the Holocene, Lethbridge, Program-with-Abstracts and Field Guide, **52.**

Location : IC
Areas : Map areas - 72 E, 72 L, 82 H
Borden areas - DO, DP, EO
Topics : Glacial chronology, Glacial lake sequences, Quaternary stratigraphy

Shetson, I.
1984 Lithostratigraphy of Glacial Deposits in Southern Alberta. GAC\MAC Joint Annual Meeting, London, Ontario, Program with Abstracts **9:106.**

Location : IC
Areas : Map areas - 72 E, 72 L, 82 H, 82 NE
Borden areas - DO, DP, EO, EP
Topics : Quaternary stratigraphy, Till - lithology

Stalker, A. MacS.
1978 The Geology of the Ice-Free Corridor: the Southern Half. AMQUA, 5th Biennial Meeting, Edmonton, Alberta, Abstracts, **19-22.**

Location : AEU, SCI, QE 696. A52
AEPAA, 551.79 AM35
Areas : Map areas - 72 E, 72 L, 82 G, 82 H, 82 NW
Borden areas - DO, DP, EO, EP
Topics : Glacial chronology, Ice-free corridor

Stalker, A. MacS.
1973 Correlation and Chronology of Cordilleran and Laurentide Glaciations in Southwestern Alberta, Canada. INQUA, 9th International Congress, Christchurch, New Zealand, Abstracts, **339-340.**

Location : ILL, MWU
Areas : Map areas - 82 G, 82 H
Borden areas - DP
Topics : Glacial chronology, Quaternary stratigraphy

Stalker, A. MacS.
1953 Surficial Geology of Southwestern Alberta. Alberta Society of Petroleum Geologists News Bulletin **1(9):8.**

Location : AEU, SCI, TN 860. A32
AEPAA and ADTMP, Periodicals collection
Areas : Map areas - 82 G, 82 H, 82 NE

Borden areas - DP, EP
Topics: Glacial chronology, Quaternary stratigraphy

Westgate, J.A.
1975 Holocene Tephra Layers in Southwestern Canada: New Units and Revision of Age Estimates. **Geological Society of America, Abstracts with Programs 7:879.**

Location: AEU, SCI, QE 1. G34 A1
Areas: Map areas - 72 E, 83 N, British Columbia - Southern
Borden areas - DO, EQ, region as above
Topics: Analysis of radiocarbon dates, Tephra - Bridge River, Tephra - Glacier Peak, Tephra - Mazama, Tephra - St. Helens

c. Central Western Corridor

Beaudoin, A.B., and R.H. King
1984 Identification of Holocene Airfall Tephra in the Southern Canadian Rockies. GAC/MAC Joint Annual Meeting, London, Ontario, Program with Abstracts 9:46.

Location : IC
Areas : Map areas - 82 N, 83 C
Borden areas - EQ, FQ
Topics : Tephra - Bridge River, Tephra - identification, Tephra - Mazama, Tephra - St. Helens

Boydell, A.N.
1971 Late-Wisconsin Events in the Foothills of Alberta, Canada, from the North Saskatchewan to the Red Deer River. Geological Society of America Abstracts with Programs 3(6):369.

Location : AEU, SCI, QE 1. G34 A1
Areas : Map areas - 82 O, 83 B, 83 C, 83 F, 83 G
Borden areas - EP, FP, FQ
Topics : Erratics Train, Faunal remains - Bison, Glacial lake sequences, Molluscs, Quaternary stratigraphy, Till - fabric, Till - lithology

Fenton, M.M., S.R. Moran, and D.N. Proudfoot
1981 Late Quaternary Stratigraphy, and History of the Calgary, Alberta, Area. GAC/MAC Joint Annual Meeting, Abstracts, 6:A-17.

Location : AEU, SCI, QE 1. P7
Areas : Map areas - 82 NE
Borden areas - EP
Topics : Glacial chronology, Quaternary stratigraphy

Harris, S.A.
1987 Nature and Age of the Last Glacial Advances in the Foothills of Alberta. INQUA, XII International Congress, Ottawa, Programme with Abstracts, 182.

Location : IC
Areas : Map areas - 82 O
Borden areas - EP
Topics : Glacial chronology, Till - lithology

Harris, S.A.

1985 History of the Last Glacial Lake Calgary Event as Indicated by the Bow River Terraces Between Cochrane and East Calgary. CANQUA Symposium on the Paleoenvironmental Reconstruction of the Late Wisconsin Deglaciation and the Holocene, Lethbridge, Program-with-Abstracts and Field Guide, 29.

Location : IC
Areas : Map areas - 82 NE
Borden areas - EP
Topics : Geomorphology - terraces, Glacial lake sequences

Harris, S.A., and J.D. Howell

1977 Final Standstill Stages and Climatic Conditions During the Last Retreat of the Rocky Mountain Ice in Southwest Alberta. Geological Society of America, Abstracts with Programs 9:730.

Location : AEU, SCI, QE 1. G34 A1 V9 1977
Areas : Map areas - 82 N
Borden areas - EQ
Topics : Glacial chronology, Tephra - Mazama

Harris, S.A., and J. Howell

1976 The Chateau Lake Louise Glacial Event in Banff National Park. Proceedings of the Canadian Association of Geographers Annual Conference, Laval, Quebec, 49-52.

Location : IC
Areas : Map areas - 82 N, 82 O
Borden areas - EP, EQ
Topics : Glacial chronology, Tephra - Mazama

King, R.H., A. Bowyer-Beaudoin and D.K. Holland

1980 Stratigraphic Evidence for Palaeoenvironmental Change in Sunwapta Pass, Jasper National Park. CAGONT/ELDAAG Joint Meeting, University of Western Ontario, London, Program and Abstracts.

Location : IC
Areas : Map areas - 83 C
Borden areas - FQ
Topics : Tephra - Mazama

Kostaschuk, R.A., G.M. MacDonald, and P.E. Putnam

1982 Alluvial-Fan Morphology, Sedimentology and History Near Banff, Alberta, Canada. AMQUA, 7th Biennial Meeting, Seattle, Washington, Program and Abstracts, 118.

Location : AEU, SCI, QE 696. A52

Areas : Map areas - 82 N, 82 O
Borden areas - EP
Topics : Geomorphology - alluvial fans, Tephra - Mazama

Kvill, D.R.
1986 **The Ice Free Corridor: A Discussion of the Evidence. CAG, 1986 Annual Meeting, Calgary, Alberta, Program and Abstracts, 81.**

Location : IC
Areas : Map areas - 83 B, 83 C
Borden areas - FP, FQ
Topics : Glacial chronology, Ice-free corridor

Kvill, D.R.
1978 **Glacial Geomorphology of the Lower Brazeau Valley. AMQUA, 5th Biennial Meeting, Edmonton, Alberta, Abstracts, 218.**

Location : AEU, SCI, QE 696. A52
AEPAA, 551.79 AM35
Areas : Map areas - 83 B, 83 C
Borden areas - FP, FQ
Topics : Glacial chronology, Glacial geomorphology

Leonard, E.M.
1987 **New Evidence on Early to Middle Holocene Glacial Activity and Environmental Change, Central Canadian Rocky Mountains. INQUA, XII International Congress, Ottawa, Programme with Abstracts, 209.**

Location : IC
Areas : Map areas - 82 N
Borden areas - EQ
Topics : Glacial chronology, Sedimentology, Tephra - Mazama

Leonard, E.M.
1982 **Holocene Glacial History, Central Canadian Rocky Mountains: Evidence from Lacustrine Sedimentary Records. AMQUA, 7th Biennial Meeting, Seattle, Washington, Program and Abstracts, 120.**

Location : AEU, SCI, QE 696. A52
AEPAA, 551.79 AM35
Areas : Map areas - 82 N
Borden areas - EQ
Topics : Glacial chronology, Sedimentology

Levson, V.M., and N.W. Rutter
1987 **Stratigraphic and Geomorphologic Evidence of Depositional Events During Glaciation and Deglaciation in the Late Wisconsinan at Jasper, Alberta. INQUA, XII International Congress, Ottawa, Programme with Abstracts, 210.**

Location : IC
Areas : Map areas - 83 SW
Borden areas - FQ
Topics : Glacial chronology

Levson, V., and N.W. Rutter
1985 **The Last Glacial in Jasper National Park. CANQUA Symposium on the Paleoenvironmental Reconstruction of the Late Wisconsin Deglaciation and the Holocene, Lethbridge, Program-with-Abstracts and Field Guide, 39.**

Location : IC
Areas : Map areas - 83 SW
Borden areas - FQ
Topics : Facies studies, Glacial chronology, Glacial lake sequences, Tephra - Mazama

Mandryk, G., and N.W. Rutter
1985 **Deglaciation Environments of the Bow Valley in the Banff-Canmore Area, Alberta. CANQUA Symposium on the Paleoenvironmental Reconstruction of the Late Wisconsin deglaciation and the Holocene, Lethbridge, Program-with-Abstracts and Field Guide, 46.**

Location : IC
Areas : Map areas - 82 O
Borden areas - EP
Topics : Glacial chronology

Osborn, G., and M. Duford
1976 **An Early Holocene Glacial Advance in the Canadian Rockies. Geological Society of America, Abstracts with Programs 8:616.**

Location : AEU, SCI, QE 1. G34 A1
Areas : Map areas - 82 N, 83 C, British Columbia - Yoho National Park
Borden areas - EQ, FQ, region as above
Topics : Glacial chronology, Tephra, Tephra - Mazama

Walker, M.J.C.
1971 **Late-Wisconsin Ice in the Morley Flats Area of the Bow Valley and Adjacent Areas of the Kananaskis Valley, Alberta. Geological Society of America, Abstracts with Programs 3(6):418.**

Location : AEU, SCI, QE 1. G34 A1
Areas : Map areas - 82 J, 82 O

Borden areas - EP
Topics: Glacial chronology, Glacial geomorphology - drumlins, Glacial lake sequences

Wilson, M.C.
1987 **Postglacial Paleohydrology and Stratigraphy, Saskatchewan River System, Western Canada: Evidence for Regional Correlations.** **INQUA, XII International Congress, Ottawa, Programme with Abstracts, 289.**

Location: IC
Areas: Map areas - 72 E, 72 L, 82 G, 82 H, 82 NE
Borden areas - DO, DP, EO, EP
Topics: Geomorphology - terraces, Glacial chronology, Paraglacial landforms, Tephra - Mazama

Wilson, M.C.
1978 **Holocene Geology and Archaeology of the Bow River Floodplain at Calgary, Alberta.** **AMQUA, 5th Biennial Meeting, Edmonton, Alberta, Abstracts, 181.**

Location: AEU, SCI, QE 696. A52
AEPAA, 551.79 AM35
Areas: Map areas - 82 NE
Borden areas - EP
Topics: Archaeology, Faunal remains - Bison, Geomorphology - terraces, Glacial chronology, Palaeosols, Tephra - Mazama

d. Northern Western Corridor

Liverman, D.G.E.
1987 Glaciolacustrine Sedimentation in the Grande Prairie Region, Alberta, Canada. INQUA, XII International Congress, Ottawa, Programme with Abstracts, 214.

Location : IC
Areas : Map areas - 83 M
Borden areas - GQ
Topics : Glacial chronology, Glacial lake sequences, Quaternary stratigraphy

Liverman, D.G.E., N.R. Catto, and N.W. Rutter
1988 Laurentide Glaciation in West-central Alberta: A Single (Late Wisconsinan) Event. GAC/MAC Joint Annual Meeting, Program with Abstracts, 13:A-74.

Location : IC, OOG
Areas : Map areas - 83 K, 83 L, 83 M, 83 N
Borden areas - GQ
Topics : Amino acid dating, Analysis of radiocarbon dates, Glacial chronology, Quaternary stratigraphy

Mathews, W.H.
1978 The Geology of the Ice-free Corridor: Discussion - Northeastern B.C. and Adjacent Alberta. AMQUA, 5th Biennial Meeting, Edmonton, Alberta, Abstracts, 16-18.

Location : AEU, SCI, QE 696. A52
AEPAA, 551.79 AM35
Areas : Map areas - 83 NW, 84 SW, British Columbia - Northeastern
Borden areas - GQ, region as above
Topics : Glacial chronology, Glacial lake sequences, Ice-free corridor

Westgate, J.A., P. Fritz, J.V. Matthews, Jr., L. Kalas, L.D. Delorme, R. Green, and R. Aario
1972 Geochronology and Palaeoecology of the Mid-Wisconsin Sediments in West-central Alberta, Canada. 24th International Geological Congress, Montreal, Abstracts, 380.

Location : AEU, SCI, QE 1. G341S
Areas : Map areas - 83 N
Borden areas - GQ
Topics : Analysis of radiocarbon dates, Glacial chronology, Insect studies, Molluscs, Ostracods, Oxygen isotope studies, Plant macrofossils - wood, Pollen analysis

e. Southeastern Alberta and Southern Saskatchewan

Christiansen, E.A.

1969 Tills in Southern Saskatchewan, Canada. Geological Society of America, Abstracts with Programs 6:5.

Location : AEU, SCI, QE 1. G34 A1
Areas : Map areas - Saskatchewan - Southern
Borden areas - region as above
Topics : Drilling, Quaternary stratigraphy, Till - chemical properties, Till - physical properties

David, P.P.

1987 The Prelate Ferry Paleosol: A New Date. GAC-MAC Joint Annual Meeting, Saskatoon, Program with Abstracts 12:36.

Location : IC, OOG
Areas : Map areas - Saskatchewan - Southern
Borden areas - region as above
Topics : Analysis of radiocarbon dates, Palaeosols

Proudfoot, D.N.

1986 A Tentative Correlation of Mid- and Late Wisconsinan Sediment Sequences Between SW Saskatchewan and SE Alberta. GAC/MAC/CGU Joint Annual Meeting, Ottawa, Program with Abstracts 11:115.

Location : IC
Areas : Map areas - 72 L, Saskatchewan - Southern
Borden areas - EO, region as above
Topics : Quaternary stratigraphy

Westgate, J.A., N.D. Briggs, A. MacS. Stalker, and C.S. Churcher

1978 Fission-track Age of Glass from Tephra Beds Associated with Quaternary Vertebrate Assemblages in the Southern Canadian Plains. Geological Society of America, 91st Annual Meeting (Joint with GAC/MAC) Abstracts with Programs, 10(7):514-515
and
GAC/MAC Joint Annual Meeting, Abstracts with Programs, 3:514-515.

Location : AEU, SCI, QE 1. G34 A1
Areas : Map areas - 72 E, 72 L
Borden areas - DO, EO
Topics : Glacial chronology, Tephra - preMazama

f. Central and East-Central Alberta

Andriashek, L.D.

1981 Quaternary Stratigraphy of the Edmonton Area, NTS 83H. **GAC/MAC Joint Annual Meeting, Program and Abstracts 6:A2.**

Location : IC, OOG
Areas : Map areas - 83 H
Borden areas - FP
Topics : Drilling, Quaternary stratigraphy, Till - lithology, Till - physical properties

g. Northern Alberta

Andriashek, L.D.

1984 Quaternary Stratigraphy of East-Central Alberta, Map Area NTS 73L. GAC/MAC Joint Annual Meeting, Program and Abstracts 9:42.

Location : IC, OOG
Areas : Map areas - 73 L
Borden areas - GO
Topics : Quaternary stratigraphy, Till - lithology

Smith, D.G., and J.L. Rhine

1985 Paraglacial Eolian Influences and Deltaic Deposits in Glacial Lake McConnell in the Lake Athabasca and Great Slave Lake Basins. CANQUA Symposium on the Paleoenvironmental Reconstruction of the Late Wisconsin Deglaciation and the Holocene, Lethbridge, Program-with-Abstracts and Field Guide, 57.

Location : IC
Areas : Map areas - 74 NW, 74 SW, 84 NE, 84 SE, Northwest Territories, Saskatchewan - Northern
Borden areas - HP, HQ, IO, IP, region as above
Topics : Glacial lake sequences, Paraglacial landforms, Sedimentology

h. Northeastern British Columbia

Bobrowsky, P.T.
1988 Ice Free Conditions in the Northern Canadian Cordillera at 18 KA and Timing of the Late Wisconsinan. AMQUA, 10th Biennial Meeting, Amherst, Massachusetts, Program and Abstracts, 108.

Location : IC
Areas : Map areas - British Columbia - Northeastern
Borden areas - region as above
Topics : Analysis of radiocarbon dates, Glacial chronology

Bobrowsky, P.T.
1987 Quaternary Stratigraphy of the Northern Canadian Cordillera Based on New Evidence from the Finlay River of Northeastern British Columbia. INQUA, XII International Congress, Ottawa, Programme with Abstracts, 132.

Location : IC
Areas : Map areas - British Columbia - Northeastern
Borden areas - region as above
Topics : Amino acid dating, Glacial chronology, Palaeomagnetism

Mathews, W.H.
1954 Quaternary Stratigraphy and Geomorphology of the Fort St. John Area, Northeastern British Columbia. Geological Society of America Bulletin 65:1345.

Location : AEU, SCI, QE 1. G341 V65 Pt 2 1954
Areas : Map areas - British Columbia - Northeastern
Borden areas - region as above
Topics : Glacial chronology, Glacial lake sequences, Quaternary stratigraphy

i. Northern United States

Carrara, P.E.

1986 Late Pleistocene Deglaciation and Reforestation of the Glacier National Park Region, Montana. AMQUA, 9th Biennial Meeting, Champaign, Illinois, Program and Abstracts, 122.

Location : AEU, SCI, QE 696. A52
Areas : Map areas - Montana - Glacier National Park
Borden areas - region as above
Topics : Analysis of radiocarbon dates, Glacial chronology, Insect studies, Plant macrofossils - needles, Plant macrofossils - wood, Tephra - Glacier Peak, Tephra - St. Helens

Carrara, P.E., and R.E. Wilcox

1984 Glacial Chronology During the Last 12,000 Years in the Glacier National Park Region, Montana. AMQUA, 8th Biennial Meeting, Boulder, Colorado, Program and Abstracts, 19.

Location : AEU, SCI, QE 696. A52
AEPAA, 551.79 AM35
Areas : Map areas - Montana - Glacier National Park
Borden areas - region as above
Topics : Dendrochronology, Glacial chronology, Neoglaciation, Plant macrofossils - wood, Tephra - Glacier Peak, Tephra - Mazama, Tephra - St. Helens

Karlstrom, E.T.

1986 Probable Ice-Wedge Casts East of Glacier Park, Northwestern Montana. AMQUA, 9th Biennial Meeting, Champaign, Illinois, Program and Abstracts, 140.

Location : AEU, SCI, QE 696. A52
Areas : Map areas - Montana - Northwestern
Borden areas - region as above
Topics : Palaeosols, Periglacial geomorphology - ice wedge casts

PART 2. LATE QUATERNARY PALAEOENVIRONMENTS

a. General

MacDonald, G.M.

1984 Postglacial Vegetation Change and Landscape Development in the Western Canadian "Ice-free" Corridor Region. AMQUA, 8th Biennial Meeting, Boulder, Colorado, Program and Abstracts, 74.

Location : AEU, SCI, QE 696. A52
AEPAA, 551.79 AM35
Areas : Map areas - 72 E, 72 L, 82 G, 82 H, 82 N, 82 NE, 83 B, 83 G, 83 J, 83 NW, 83 SW, 84 C, 84 D, British Columbia - Northeastern, Northwest Territories, Yukon
Borden areas - DO, DP, EP, EQ, FP, FQ, GP, GQ, HQ, regions as above
Topics : Ice-free corridor, Pollen analysis, Vegetation history

MacDonald, G.M., and J.C. Ritchie

1985 Postglacial Palaeoecology of the Western Canadian Interior: Progress and Problems. CANQUA Symposium on the Paleoenvironmental Reconstruction of the Late Wisconsin Deglaciation and the Holocene, Lethbridge, Program-with-Abstracts and Field Guide, 42.

Location : IC
Areas : Map areas - All Alberta, Manitoba, Northwest Territories, Saskatchewan
Borden areas - All Alberta, regions as above
Topics : Pollen analysis, Review of palaeoenvironmental studies

Murray, D.F.

1978 Megaberingian Floristic Elements and the Palaeoecology of the Ice-free Corridor. AMQUA, 5th Biennial Meeting, Edmonton, Alberta, Abstracts, 35-37.

Location : AEU, SCI, QE 696. A52
AEPAA, 551.79 AM35
Areas : Map areas - 72 E, 72 L, 82 G, 82 H, 82 N, 82 NE, 83 B, 83 G, 83 J, 83 NW, 83 SW, 84 C, 84 D, Alaska, British Columbia - Northeastern, Northwest Territories, Yukon
Borden areas - DO, DP, EP, EQ, FP, FQ, GP, GQ, HQ, regions as above
Topics : Ice-free corridor, Pollen analysis, Vegetation history - Populus

Packer, J.G.

1978 Palaeoecology of the Ice-free Corridor. AMQUA, 5th Biennial Meeting, Edmonton, Alberta, Abstracts, 38.

Location : AEU, SCI, QE 696. A52
AEPAA, 551.79 AM35
Areas : Map areas - 72 E, 72 L, 82 G, 82 H, 82 N, 82 NE, 83 B, 83 G, 83 J, 83 NW, 83 SW, 84 C, 84 D, British Columbia - Northeastern, Northwest

Territories, Yukon
Borden areas - DO, DP, EP, EQ, FP, FQ, GP, GQ, HQ, regions as above
Topics: Ice-free corridor, Review of palaeoenvironmental studies

Ritchie, J.C.
1978 The Palaeoecology of the Ice-free Corridor. AMQUA, 5th Biennial Meeting, Edmonton, Alberta, Abstracts, 24-30.

Location: AEU, SCI, QE 696. A52
AEPAA, 551.79 AM35
Areas: Map areas - 72 E, 72 L, 82 G, 82 H, 82 N, 82 NE, 83 B, 83 G, 83 J, 83 NW, 83 SW, 84 C, 84 D, Alaska - Eastern, British Columbia - Northeastern, Northwest Territories, Yukon
Borden areas - DO, DP, EP, EQ, FP, FQ, GP, GQ, HQ, regions as above
Topics: Ice-free corridor, Review of palaeoenvironmental studies

Vance, R.E.
1985 Late Quaternary Paleoecology of Alberta. CANQUA Symposium on the Paleoenvironmental Reconstruction of the Late Wisconsin Deglaciation and the Holocene, Lethbridge, Program-with-Abstracts and Field Guide, 61.

Location: IC
Areas: Map areas - All Alberta
Borden areas - All Alberta
Topics: Pollen analysis - multivariate statistical methods, Vegetation history

Vitt, D.H., and D.G. Horton
1978 Plant Survival in Beringia and in Refugia Along the Canadian Rocky Mountains During Pleistocene Glaciation as Suggested by Present Bryophyte Distribution Patterns. AMQUA, 5th Biennial Meeting, Edmonton, Alberta, Abstracts, 235.

Location: AEU, SCI, QE 696. A52
AEPAA, 551.79 AM35
Areas: Map areas - 72 E, 72 L, 82 G, 82 H, 82 N, 82 NE, 83 B, 83 G, 83 J, 83 NW, 83 SW, 84 C, 84 D, Alaska, British Columbia - Northeastern, Northwest Territories, Yukon
Borden areas - DO, DP, EP, EQ, FP, FQ, GP, GQ, HQ, regions as above
Topics: Plant refugia, Vegetation history - Bryophytes

b. Central Western Corridor

Beaudoin, A.B.
1985 A Discussion of Holocene Timberline Fluctuations in Jasper National Park. CANQUA Symposium on the Paleoenvironmental Reconstruction of Late Wisconsin Deglaciation and the Holocene, Lethbridge, Program-with-Abstracts and Field Guide, 17-18.

Location : IC
Areas : Map areas - 83 C
Borden areas - FQ
Topics : Holocene timberline fluctuations, Pollen analysis, Pollen ratios, Tephra - Mazama, Vegetation history

Beaudoin, A.B., and R.H. King
1984 A Holocene Pollen Record from Wilcox Pass, Jasper National Park. Sixth International Palynological Conference, Calgary, Abstracts, 8.

Location : IC
Areas : Map areas - 83 C
Borden areas - FQ
Topics : Pollen analysis, Tephra - Mazama, Vegetation history

Bombin, E.R.
1980 Ontogeny of Mary Gregg Lake, Alberta, Canada. AMQUA, 6th Biennial Meeting, Orono, Maine, Abstracts and Program, 33.

Location : AEU, SCI, QE 696. A52
AEPAA, 551.79 AM35
Areas : Map areas - 83 F
Borden areas - FQ
Topics : Diatoms, Lake cores, Pollen analysis, Sediments - chemistry, Tephra - Mazama, Vegetation history

Bombin, E.R., and M. Bombin
1980 Post-glacial Vegetational History of the Area of Mary Gregg Lake, Alberta, Canada. 5th International Palynological Conference, Cambridge, England, Abstracts, 48.

Location : IC
Areas : Map areas - 83 F
Borden areas - FQ
Topics : Lake cores, Pollen analysis, Tephra - Mazama

Bowyer-Beaudoin, A.

1982 Holocene Palaeoenvironmental Change and the Local Pollen Record in Sunwapta Pass, Jasper National Park, Alberta. AMQUA, Seventh Biennial Conference, Seattle, Washington, Abstracts, 74.

Location : IC
Areas : Map areas - 83 C
Borden areas - FQ
Topics : Pollen analysis, Tephra - Mazama, Vegetation history

Holland, D.K., A. Bowyer-Beaudoin and K.B. Cawker

1980 Palaeoenvironmental Change in Sunwapta Pass, Jasper National Park, Alberta. CAGONT/ELDAAG Joint Meeting, University of Western Ontario, London, Program and Abstracts.

Location : IC
Areas : Map areas - 83 C
Borden areas - FQ
Topics : Pollen analysis, Tephra - Mazama

Holland, D.K., A. Bowyer-Beaudoin and K.B. Cawker

1980 Investigation of Palaeoenvironmental Change in Sunwapta Pass, Jasper National Park, Alberta. AMQUA, 6th Biennial Meeting, Orono, Maine, Abstracts and Program, 101.

Location : IC
Areas : Map areas - 83 C
Borden areas - FQ
Topics : Pollen analysis, Tephra - Mazama

Holland, D.K., A. Bowyer-Beaudoin and K.B. Cawker

1980 A Holocene Pollen Record from Sunwapta Pass, Jasper National Park, Alberta. 5th International Palynological Conference, Cambridge, England, Abstracts, 176.

Location : IC
Areas : Map areas - 83 C
Borden areas - FQ
Topics : Pollen analysis, Tephra - Mazama

Luckman, B.H.

1984 Oxygen Isotope studies from Tree Rings in the Canadian Rockies. GAC/MAC Joint Annual Meeting, London, Ontario, Program with Abstracts 9:85.

Location : IC
Areas : Map areas - 82 N, 83 C
Borden areas - EQ, FQ
Topics : Dendroecology, Oxygen isotope studies

Reasoner, M.A.
1987 A Paleoenvironmental Study of the Lake O'Hara Region, Yoho National Park, British Columbia, Canada. INQUA, XII International Congress, Ottawa, Programme with Abstracts, 250.

Location : IC
Areas : Map areas - 82 N, British Columbia - Yoho National Park
Borden areas - EQ, region as above
Topics : Holocene timberline fluctuations, Lake cores, Plant macrofossils - needles, Pollen analysis, Tephra - Bridge River, Tephra - Mazama, Vegetation history

Schweger, C.
1985 A 24,000 Year Pollen Record from Goldeye Lake, Alberta - Implications to the Paleoecology of the Ice-free Corridor. CANQUA Symposium on the Paleoenvironmental Reconstruction of the Late Wisconsin Deglaciation and the Holocene, Lethbridge, Program-with-Abstracts and Field Guide, 55.

Location : IC
Areas : Map areas - 83 C
Borden areas - FQ
Topics : Ice-free corridor, Lake cores, Pollen analysis, Tephra - St. Helens, Tephra - Mazama, Vegetation history

Schweger, C., and M. Hickman
1980 Postglacial Palynology and Paleolimnology, Alberta, Western Canada. 5th International Palynological Conference, Cambridge, England, Abstracts, 357.

Location : IC
Areas : Map areas - 73 L, 83 C
Borden areas - FQ, GO
Topics : Diatoms, Lake cores, Palaeolimnology, Pollen analysis, Vegetation history

c. Northern Western Corridor

Westgate, J.A., P. Fritz, J.V. Matthews, Jr., L. Kalas, and R. Green

1971 Sediments of Mid-Wisconsin Age in West-central Alberta: Geochronology, Insects, Ostracodes, Mollusca, and the Oxygen Isotopic Composition of Molluscan Shells. Geological Society of America, Abstracts with Programs, Rocky Mountain Section 24th Annual Meeting, 3(6):419.

Location : AEU, SCI, QE 1. G34 A1
Areas : Map areas - 83 N
Borden areas - GQ
Topics : Glacial chronology, Glacial lake sequences, Insect studies, Molluscs, Plant macrofossils - seeds, Plant macrofossils - seeds, Ostracods, Oxygen isotope studies

Wright, M.

1988 Brassy Minnows and Early Man - Ice Free Corridor Research in Northwest Alberta. Canadian Archaeological Association, 21st Annual Meeting, Whistler, British Columbia, Programme and Abstracts, 50.

Location : IC
Areas : Map areas - 83 L, 83 M
Borden areas - GQ
Topics : Biogeography - brassy minnows, Glacial lake sequences, Ice-free corridor

d. Central and East-Central Alberta

Hickman, M., and C.E. Schweger
1987 Holocene Paleohydrology of Central Alberta, Canada. INQUA, XII International Congress, Ottawa, Programme with Abstracts, 187.

Location : IC
Areas : Map areas - 73 L, 83 A, 83 C, 83 F, 83 G, 83 H, 84 H
Borden areas - FP, FQ, GO, HP
Topics : Diatoms, Lake cores, Pigments, Pollen analysis, Sediments - chemistry

Holloway, R.G.
1980 Absolute Pollen Analysis of Lake Wabamun, Alberta, Canada. Palynology 4:243-244.

Location : AEU, SCI, QE 993. P18 V4 1980
Areas : Map areas - 83 G
Borden areas - FP
Topics : Lake cores, Pollen analysis, Vegetation history

PART 3. LATE QUATERNARY PALAEONTOLOGY

a. General

Lindsey, C.C.
1978 Aquatic Zoogeography and the Ice-Free Corridor. AMQUA, 5th Biennial Meeting, Edmonton, Alberta, Abstracts, 31-34.

Location : AEU, SCI, QE 696. A52
AEPAA, 551.79 AM35
Areas : Map areas - 72 E, 72 L, 82 G, 82 H, 82 N, 82 NE, 83 B, 83 G, 83 J, 83 NW, 83 SW, 84 C, 84 D, British Columbia - Northeastern, Northwest Territories, Yukon
Borden areas - DO, DP, EP, EQ, FP, FQ, GP, GQ, HQ, regions as above
Topics : Biogeography - fish, Faunal remains - fish, Ice-free corridor, Zooplankton

b. Northeastern British Columbia

Driver, J.C.

1988 The Significance of the Late Pleistocene/Early Holocene Fauna from Charlie Lake Cave. Canadian Archaeological Association, 21 Annual Meeting, Whistler, British Columbia, Program and Abstracts, 35.

Location : IC
Areas : Map areas - British Columbia - Northeastern
Borden areas - HR, region as above
Topics : Archaeological sites - HbRf-39, Cave deposits, Faunal remains

Fladmark, K.R.

1988 Charlie Lake Cave. Canadian Archaeological Association, 21 Annual Meeting, Whistler, British Columbia, Program and Abstracts, 36.

Location : IC
Areas : Map areas - British Columbia - Northeastern
Borden areas - HR, region as above
Topics : Archaeological sites - HbRf-39, Cave deposits, Faunal remains

SECTION E. IN-HOUSE REPORTS, FIELD-TRIP GUIDES, AND UNPUBLISHED PAPERS

PART 1. LATE QUATERNARY GEOLOGY

a. General

Dormaar, J., L.V. Hills, B. Luckman, G. Osborn, B.O.K. Reeves, N.W. Rutter, M.C. Wilson, and N.R. Catto

1987 Quaternary of the South and Central Rocky Mountains and Foothills of Alberta and British Columbia. INQUA XII International Congress, Excursion Guide Book C-16. (54 pp.)

Location : IC
Areas : Map areas - 82 G, 82 H, 82 N, 82 NE, 83 A, 83 G, 83 H, 83 SW
Borden areas - DP, EP, FP, FQ
Topics : Archaeological sites - DkPj-1, Archaeological sites - DjPo-137, DjPo-138 and DjPo-139, Erratics Train, Field trip guide, Geomorphology - terraces, Glacial chronology, Glacial geomorphology, Glacial lake sequences, Holocene timberline fluctuations, Palaeosols, Pollen analysis, Quaternary stratigraphy, Tephra - Bridge River, Tephra - Mazama, Tephra - St. Helens, Vegetation history

Evans, D.J.A.

1985 Wisconsin Ice Dynamics in Alberta: A Review of Prevalent Hypotheses and the Development of Recent Ideas. In Proceedings of Canadian Association of Geographers Annual Meeting, Université du Québec à Trois Rivières, edited by R. Pelletier and L. Destraies, pp. 13-33.

Abstract : No abstract available
Location : IC
Areas : Map areas - All Alberta
Borden areas - All Alberta
Topics : Ice movement indicators, Review of ice dynamics

b. Southern Western Corridor

Fenton, M.M., J.G. Pawlowicz, J.R. Vickers
1987 Supplement to Guidebook, Alberta Portion of the Trip. INQUA XII International Congress, Ottawa, Field Trip C-13. (38 pp.)

Location : IC
Areas : Map areas - 72 E, 72 L, 72 M, 82 H, 82 I, 82 J, 82 O, 82 P
Borden areas - DO, DP, EO, EP
Topics : Archaeological sites - DkPj-1, Archaeological sites - DlOv-2, Archaeological sites - EaPe-1, Field trip guide, Glacial chronology, Palaeosols, Review of archaeology, Quaternary stratigraphy, Tephra - Glacier Peak, Tephra - Mazama

Forbis, R.G.
1982 Final Report on Investigations at the Taber Child Site, Alberta. Manuscript on file, Archaeological Survey of Alberta, Edmonton, Alberta. (16 pp.)

Location : AEA, HSS/ASA, CRM 25
Areas : Map areas - 82 H
Borden areas - DP
Topics : Archaeological sites - DlPa-4, Taber child

Jackson, Jr., L.E.
1981 Quaternary Stratigraphy of the Region Between Calgary and the Porcupine Hills. GAC/MAC/CGU Joint Meeting, Calgary, Field Guides to Geology and Mineral Deposits, 79-99.

Location : AEU, SCI, QE 185. F45
Areas : Map areas - 82 J
Borden areas - EP
Topics : Erratics Train, Field trip guide, Glacial chronology, Glacial lake sequences, Quaternary stratigraphy, Till - heavy minerals, Till - lithology

Karlstrom, E.T.
1987 Zone of Interaction Between Laurentide and Rocky Mountain Glaciers East of Waterton-Glacier Park, Northwestern Montana and Southwestern Alberta. In Rocky Mountain Section of the Geological Society of America Centennial Field Guide, Volume 2, edited by S.S. Beus, 19-24.

Location : ILL
Areas : Map areas - 82 H, Montana - Glacier National Park
Borden areas - DP, region as above
Topics : Field trip guide, Glacial chronology, Glacial lake sequences, Palaeosols, Quaternary stratigraphy

Karlstrom, E.T.
1987 Multiple Soils in Pre-Wisconsin Drift on Mokowan Butte, Southwestern Alberta. In Rocky Mountain Section of the Geological Society of America Centennial Field Guide, Volume 2, edited by S.S. Beus, 25-28.

Location : ILL
Areas : Map areas - 82 H, Montana - Glacier National Park
Borden areas - DP, region as above
Topics : Field trip guide, Glacial chronology, Palaeomagnetism, Palaeosols, Quaternary stratigraphy, Soil - chemical properties, Soil - physical properties

Rutter, N.W. and E.A. Christiansen
1972 Quaternary Geology and Geomorphology Between Winnipeg and the Rocky Mountains. XXIV International Geological Congress, Montreal, Excursion 22. (101 pp.)

Location : IC
Areas : Map areas - 72 E, 72 L, 82 H, 82 NE, Manitoba - Southern, Saskatchewan - Southern
Borden areas - DO, DP, EO, EP, region as above
Topics : Drilling, Field trip guide, Geomorphology - sand dunes, Glacial chronology, Glacial geomorphology, Glacial lake sequences, Quaternary stratigraphy

Schreiner, B.T., L.A. Dredge, E. Nielsen, R.W. Klassen, M.M. Fenton, and J.R. Vickers
1987 The Quaternary Between Hudson Bay and the Rocky Mountains. INQUA XII International Congress, Ottawa, Excursion Guide Book C-13. (45 pp.)

Location : IC
Areas : Map areas - 72 E, 72 L, 82 G, 82 H, 82 I, 82 J, Manitoba, Saskatchewan
Borden areas - DO, DP, EO, EP, region as above
Topics : Archaeological sites - Southern Alberta, Field trip guide, Glacial chronology, Glacial geomorphology, Quaternary stratigraphy, Till - physical properties

Stalker, A. MacS.
1957 Some Features of the Surficial Geology of the Fort Macleod Region of Alberta. In Alberta Society of Petroleum Geologists, 7th Annual Field Conference Guidebook, edited by E.W. Jennings and C.R. Hemphill, pp. 52-63.

Location : AEU, SCI, TN 863. A33
Areas : Map areas - 82 H, 82 I
Borden areas - DP, EP
Topics : Erratics Train, Field trip guide, Glacial chronology, Glacial geomorphology, Quaternary stratigraphy

Stalker, A. MacS.

1953 Surficial Geology of Southwestern Alberta. Alberta Society of Petroleum Geologists, 3rd Annual Field Conference and Symposium, 15-22.

Location : IC
Areas : Map areas - 82 G, 82 H, 82 I, 82 J
Borden areas - DP, EP
Topics : Field trip guide, Quaternary stratigraphy

Stalker, A. MacS., and R.W. Barendregt

1988 Megablocks East of Lethbridge. Field Excursion Guidebook, "Stalkerfest", October 29th, 1988. Department of Geography, University of Lethbridge, Alberta.

The purpose of this field excursion is to demonstrate some types of "megablocks" ... found on the southwestern Great Plains of Canada, and to view features associated with them. ...

A megablock is an immense mass of material that has been "rafted" into place by a glacier, often with surprisingly little distortion. ... The writers consider that, on the Prairies, the glaciers may have quarried and transported more debris as magablocks than by any other method. Most megablocks, of course, probably are broken up and dispersed during ice transport and deposition, or by subsequent glaciers, ... They are not limited to a single age of glaciation, but appear to have been features of most glaciations on the prairies. However, the writers consider that they are features solely of Laurentide glaciers, and to date none have been found that were moved into place by Cordilleran ice.

Abstract : Part of Authors' text
Location : IC
Areas : Map areas - 72 E, 82 H
Borden areas - DO, DP
Topics : Bedrock blocks, Field trip guide, Megablocks

Wilson, M., and D. Harvey

1982 Geoarchaeological Investigations of the Age and Context of the Stalker ("Taber Child") Site, DlPa-4, Alberta. Appendix to Final Report on Investigations at the Taber Child Site, Alberta, by R.G. Forbis. Manuscript on file, Archaeological Survey of Alberta, Edmonton, Alberta. (50 pp.)

Detailed archaeological excavations were carried out in 1978 and 1979 at the Stalker Site (DlPa-4), north of Taber, Alberta. Their purpose was to clarify the stratigraphic sequence at the site, to evaluate the probable context of the human remains, and to search for additional human or faunal remains. A variety of Quaternary deposits was exposed, including tills, intertill sands, iced-contact lacustrine deposits, Holocene slope deposits, and mudflow deposits. Slope retreat in recent years has not been as extensive at the site as was originally believed, and Holocene deposits from an earlier gully cycle were identified. Diamictons that initially appeared to be till blocks in the orange intertill sands at the site proved upon excavation to be Holocene mudflows, and contained bones (bison and jackrabbit). Bones of these species and pronghorn antelope were also recovered from Holocene slope deposits. Sediment samples from the various units and from the "Taber Child" specimen were subjected to semi-quantitative X-ray diffraction spectrometry and percentage compositions of major mineral constituents were compared. The "Taber Child" matrix was diamictic and did not resemble sediment samples from the orange (rusty) intertill sands formerly thought to be the deposit of origin. Closer resemblances were noted with other deposits, including the Holocene mudflows. Given the presence of mudflow deposits within about one metre of the estimated discovery point, it is concluded that the "Taber Child" specimen could reasonably have come from Holocene deposits at the site. Cementation of matrix around the fossil was due to seepage at the site and is not an indicator of great antiquity.

Location : AEA, HSS/ASA, CRM 25
Areas : Map areas - 82 H
Borden areas - DP
Topics : Archaeological sites - DlPa-4, Diamicton - mineralogy, Diamicton - physical characteristics, Faunal remains - Antilocapra, Faunal remains - Bison, Faunal remains - Lepus, Geoarchaeology, Palaeomagnetism, Quaternary stratigraphy, Taber child

c. Central Western Corridor

Baranowski, S., and W.E.S. Henoch

1978 Glacier and Landform Features in the Columbia Icefield Area, Banff and Jasper National Parks, Alberta, Canada. Supplementary Report on a Study carried out for Parks Canada by Glaciology Division, Inland Waters Directorate, Environment Canada. (158 pp.)

Location : AEPAA, 551.314 G451
Areas : Map areas - 83 C
Borden areas - FQ
Topics : Geomorphology - karst, Glacial geomorphology, Neoglaciation, Tephra - Mazama, Tephra - probable Bridge River

Broscoe, A.J., and R.H. Barton

1959 Geomorphology of the Drumheller-Morrin Area, South-Central Alberta. In Alberta Society of Petroleum Geologists 9th Annual Field Conference, Moose Mountain-Drumheller, Guidebook, edited by G.H. Austin, pp. 20-22.

The Drumheller-Morrin Area is underlain by Upper Cretaceous and Tertiary marine, brackish-water and continental sediments, dipping very gently to the west into the Alberta syncline. The bedrock is obscured by two till sheets and a disintegration moraine, which includes central-depression prairie mounds, moraine plateaus, and disintegration ridges. Extensive Pleistocene lake deposits accumulated in three lake stages at successively lower levels. The rapid down-cutting by the Red Deer River, probably in post-glacial time, is thought to be the result of an increased discharge due to diversion of the present headwaters of the Red Deer River into the present system north of the town of Red Deer. Rapid erosion of the nonresistant Edmonton formation exposed in the valley walls resulted in the formation of spectacular badlands which are undergoing further erosion at the present time.

Location : AEU, SCI, TN 863. A33
Areas : Map areas - 82 P
Borden areas - EP
Topics : Field trip guide, Glacial geomorphology, Glacial lake sequences

Holter, M.

1973 Quaternary Stratigraphy of Central Alberta. Research Council of Alberta Open File Report 1973-24. (29 pp.)

The area of study ... is a critical area for Quaternary stratigraphic studies for the following reasons:

1. Surficial mapping programs have been completed on the entire area thus providing continuous coverage between areas of confirmed Cordilleran and Rocky Mountain glaciation in the west and continental glaciation to the east. This is one of the first such documented cases in the province.

2. Studies within the area afford some appreciation of the relationships between separate lithological units both in a vertical and lateral stratigraphic sense. ...

At least three major tills of Laurentide origin are evidence of three distinct periods of continental glaciation in the area, two of which are probably pre-Wisconsin. A minimum of three advances of Rocky Mountain glaciation of Wisconsin age have been recorded. A region of till cover resulting from mixed glaciation occurs between the two pre-existing ice sheets.

Deglaciation was complete in the western part of the area soon after 9,600 years B.P. Ponding of melt water upon glacial retreat led to the development of a series of glacial lakes. The resultant establishment of spillways altered regional drainage to the southeast.

Abstract : Adapted from Author's Introduction and Conclusions
Location : ADTMP, QE 186. R4 O6 1973-24
ARC, Open File Report 1973-24
Areas : Map areas - 82 P, 83 A, 83 B
Borden areas - EP, FP
Topics : Archaeology - site distribution, Geomorphology - dunes, Glacial chronology, Glacial lake sequences, Quaternary stratigraphy

Kucera, R.E., and W.E.S. Henoch
1978 Glacier and Landform Features in the Columbia Icefield Area, Banff and Jasper National Parks, Alberta. Report of a Study carried out for Parks Canada by Glaciology Division, Inland Waters Directorate, Environment Canada. (131 pp.)

Location : AEPAA, 551.314 G451
Areas : Map areas - 83 C
Borden areas - FQ
Topics : Geomorphology, Glacial geomorphology, Glaciology

Luckman, B.H., and M.S. Kearney
1978 Analysis and Interpretation of a Holocene Deposit from Castleguard Meadows, Banff National Park, Alberta. Report to Environment Canada, Ottawa, Contract KL 229-7-2083.

Note : Report is appended to Baranowski and Henoch (1978)
Location : AEPAA, 551.314 G451
Areas : Map areas - 83 C
Borden areas - FQ
Topics : Analysis of radiocarbon dates, Sediments - physical properties, Tephra - composition, Tephra - Mazama, Tephra - probable Bridge River

McPherson, H.J., and H.O. Slaymaker
1972 Geomorphology of the Canadian Cordillera. Guide Book for Event Ca6 of the International Geographical Congress. (85 pp.)

Abstract : No abstract available
Location : AEU, SCI, GB 428.5 C2 M47 1972
Areas : Map areas - 82 N, 82 O, 83 SW, British Columbia - Southern
Borden areas - EQ, FQ, region as above
Topics : Field trip guide, Geomorphology - Canadian Rockies, Glacial history

Proudfoot, D.N., R.W. May, N.W. Rutter, and J. Shaw
1982 Excursion 20B: Glacial and Postglacial Sediments Edmonton-Jasper-Banff-Calgary Area, Alberta, Field Excursion Guidebook: International Association of Sedimentologists, Eleventh International Congress on Sedimentology, McMaster University, Hamilton. (159 pp.)

Abstract : No abstract available.
Location : ADTMP, QE 472. F454
Areas : Map areas - 82 O, 82 P, 83 SE, 83 SW
Borden areas - EP, FP, FQ
Topics : Field trip guide, Glacial chronology, Glacial geomorphology, Quaternary stratigraphy, Sedimentology

Proudfoot, D.N., S.R. Moran and N.W. Rutter
1981 The Quaternary Stratigraphy and Geomorphology of Southwest/ Central Alberta. In 1981 Annual Meeting of Geological Association of Canada, Calgary, Field Trip Guide, 225-259.

Abstract : No abstract available
Location : ILL, ACSP
Areas : Map areas - 82 N, 82 O, 82 P, 83 A, 83 B, 83 C
Borden areas - EP, EQ, FP, FQ
Topics : Field trip guide, Glacial chronology, Quaternary stratigraphy, Tephra - Bridge River. Tephra - Mazama, Tephra - St. Helens

Rutter, N.W.
1971 Quaternary Geology Road Logs - Banff Area, Alberta. Geological Survey of Canada Paper 70-67. (25 pp.)

This paper contains six road logs dealing with aspects of the Quaternary geology in the area of Banff, Alberta.

Location : AEU, SCI, QE 185. C2
Areas : Map areas - 82 N, 82 O
Borden areas - EP, EQ
Topics : Field trip guide, Glacial chronology

Schweger, C., J. Hrapko, B. Luckman, G. Osborn, M. Roed, D. Sharp, and D. Vitt
1978 Guide Book - AMQUA Post-Conference Field Trip - Edmonton-Rocky Mountains-Edmonton, September 4-6, 1978. 5th AMQUA Biennial Meeting, Edmonton, Alberta. (75 pp.)

Location : IC
Areas : Map areas - 82 N, 83 C, 83 D, 83 F, 83 G, 83 H
Borden areas - EQ, FP, FQ
Topics : Field trip guide, Glacial chronology

Stalker, A. MacS.

1975 The Big Rock. In Structural Geology of the Foothills between Savannah and Panther River, Southwestern Alberta, edited by H.J. Evers and J.E. Thorpe, pp. 9-11. Guidebook, Joint Convention of Canadian Society of Petroleum Geologists and Canadian Society of Economic Geophysicists, Exploration Update 1975.

Abstract : No abstract available
Location : AEU, SCI, QE 186. S92
Areas : Map areas - 82 I
Borden areas - EP
Topics : Erratics - Okotoks, Erratics train, Field trip guide

Williams, G.D., and L.A. Bayrock

1966 Surficial Geology Between Edmonton and Cadomin Near Highways 16 and 17. Eighth Annual Field Trip Guidebook, Edmonton Geological Association, 105-134.

From the western outskirts of Edmonton west to the junction of Highway 47, a distance of about 128 miles, Highway 16 traverses Pleistocene deposits of till, lacustrine and deltaic clays and silts, and fluvial sands and gravels. Bedrock, comprising sandstones of the Tertiary Paskapoo Formation and sandstones, shales, carbonaceous shales and coals of the Upper Cretaceous Edmonton Formation is exposed beneath the surficial deposits in stream and river valleys, road cuts, borrow pits and strip mines.

Highway 47, from its junction with Highway 16, 6 1/2 miles west of Edson, south to Cadomin crosses surficial deposits of recent alluvium, Pleistocene till, lacustrine clays and silts, and Pleistocene or post-Pleistocene sand dunes. Mesozoic to Tertiary conglomerates, sandstones, siltstones, shales and coals are exposed beneath surface materials in road cuts, river and stream valleys and foothill ridges.

On the Plains east of Edson, relief is mostly a function of the type of Pleistocene deposits found at the surface. West and south of Edson, the topography was formed mainly by Tertiary fluvial erosion. The Foothills were over-ridden by glaciers during the Pleistocene, but the higher peaks of the Mountains stood as nunataks above the ice.

Laurentian and Cordilleran ice sheets merged near Edson producing a zone five to twenty miles wide of till with characteristics of both continental and mountain tills. West of Edson only Cordilleran till is found and east of the mixed till zone only continental glacial deposits are present.

Location : ARC, Contribution Series 350
Areas : Map areas - 83 F, 83 G, 83 H
Borden areas - FP, FQ
Topics : Field trip guide, Glacial chronology, Quaternary stratigraphy

d. Northern Western Corridor

Bobrowsky, P.T., V. Levson, D.G.E. Liverman, and N.W. Rutter
1987 Quaternary Geology of Northwestern Alberta and Northeastern British Columbia. INQUA XII International Congress, Ottawa, Excursion Guide Book A-24. (62 pp.)

Location : IC
Areas : Map areas - 83 M, 83 SW, British Columbia - Northeastern
Borden areas - FQ, GQ, region as above
Topics : Field trip guide, Glacial chronology, Quaternary stratigraphy, Till - fabric, Till - lithology, Till - physical properties

e. Southeastern Alberta and Southern Saskatchewan

Berg, T.

1969 Stratigraphic Problems in Southeast Alberta. Manuscript prepared for 19th Midwest Friends of the Pleistocene 1969 Field Conference, Saskatchewan and Alberta. (6 pp.)

Note : Paper handed out to field trip participants only. Not available from any library source.
Abstract : No abstract available
Location : IC
Areas : Map areas - 72 E, 72 L, Saskatchewan - Southern
Borden areas - DO, EO, region as above
Topics : Analysis of radiocarbon dates, Faunal remains - Antilocapra, Field trip guide, Glacial chronology, Palaeosols, Quaternary stratigraphy, Till - heavy minerals, Till - lithology

Broscoe, A.J.

1965 The Geomorphology of the Cypress Hills-Milk River Canyon Area, Alberta. 15th Annual Field Conference Guidebook, Part 1, Cypress Hills Plateau, edited by R.L. Zell, pp. 74-84. Alberta Society of Petroleum Geologists.

The Cypress Hills are erosional remnants of an extensive depositional plain, the Cypress Plain, of Oligocene age. Remnants of three gravel-capped benches, including the Flaxville Plain, slope away from the Cypress Hills. The preglacial divide between the ancestral Missouri and South Saskatchewan rivers formed a low, broad ridge connecting the Cypress and Sweetgrass hills. Preglacial streams radiated from the Cypress Hills and flowed northwest and southeast from the old divide.

The Laurentide ice sheet covered all but the high Cypress Hills upland. Ice flow was to the southeast, across the old divide. During deglaciation, meltwater streams cut several large channels across the divide and in other parts of the Cypress Hills area. Milk River Canyon originated as a meltwater channel and carried meltwater from a large area to the west.

Rapid postglacial erosion in areas marginal to the deeper meltwater channels has removed much of the glacial deposits and cut badlands into the bedrock. Sediment from the badlands is deposited on the meltwater channel floors.

Location : AEU, SCI, TN 863. A33 15th 1965 Part 1
Areas : Map areas - 72 E
Borden areas - DO
Topics : Geomorphology, Glacial chronology, Glacial geomorphology, Glacial lake sequences

Christiansen, E.A.

1969 Pleistocene Stratigraphy of the Swift Current Creek, Prelate Ferry, Empress, and Medicine Hat Sections. Manuscript prepared for 19th Midwest Friends of the Pleistocene Field Conference, Saskatchewan and Alberta. (24 pp.)

Note : Paper handed out to field trip participants only.

Location : IC
Areas : Map areas - 72 L, Saskatchewan - Central, Saskatchewan - Southern
Borden areas - EO, region as above
Topics : Field trip guide, Glacial chronology, Palaeosols, Quaternary stratigraphy, Till - lithology, Till - physical properties

David, P.P.

1969 A Reappraisal of the Prelate Ferry Paleosol. Manuscript prepared for 19th Midwest Friends of the Pleistocene, 1969 Field Conference, Saskatchewan and Alberta. (34 pp.)

This report was prepared entirely for the 1969 meetings of the Midwest Friends of the Pleistocene. Its purpose is to focus attention to the data that has accumulated during the past three years about the Prelate Ferry Paleosol and the sediments that are related to it. Based on the newly acquired data an attempt will be made to reevaluate the paleosol and associated sediments. They will in turn be used to interpret the local climatic and physiographic conditions that prevailed in these parts of Canada just prior to the advance of the last glacier. The non-glacial period that was ended by the advance of the glacier was named, after the paleosol, the Prelate Ferry Interval (David, 1964).

Abstract : Author's Preamble
Location : AEU, HSS, QE 473. D24 1969
Areas : Map areas - Saskatchewan - Southern
Borden areas - region as above
Topics : Palaeosols, Quaternary stratigraphy, Soil - chemical properties, Soil - physical properties, Till - physical properties

Stalker, A. MacS.

1965 Pleistocene Ice Surface, Cypress Hills Area. 15th Annual Field Conference Guidebook, Part 1, Cypress Hills Plateau, edited by R.L. Zell, pp. 116-130. Alberta Society of Petroleum Geologists.

During the period of maximum ice thickness, the surface of the strongest Pleistocene glacier that covered southern Alberta and southwestern Saskatchewan sloped downward to the south-southeast at a rate of about 13 ft. to a mile. At this time, direction of the ice flow was in the same direction, or roughly parallel to the front of the Rocky Mountains to the west and the high land of the Hudson Bay Divide to the south. The surface of the last major Wisconsin ice-sheet, at greatest extent and maximum thickness of this glacier, also sloped downward to the south-southeast, though at a significantly lower rate. The ice flowed in a similar direction. The flow-patterns changed markedly as the glaciers retreated and their surfaces lowered, however, and southwestward movement became predominant during latter stages of ice withdrawal from the prairies. The strongest Pleistocene glacier, at its maximum, had a general thickness of 1,500 to 2,500 ft. in the region. The last major Wisconsin glacier, at its maximum, had a general thickness of 1,000 to 2,000 ft.

Location : AEU, SCI, TN 863. A33 15th 1965 Part 1
Areas : Map areas - 72 E, 72 F, 82 H, Saskatchewan - Southern
Borden areas - DO, DP, region as above
Topics : Reconstruction of ice surface

Westgate, J.A.

1965 The Pleistocene Stratigraphy of the Foremost-Cypress Hills Area, Alberta. In 15th Annual Field Conference Guidebook, Part 1, Cypress Hills Plateau, edited by R.L. Zell, pp. 85-111. Alberta Society of Petroleum Geologists.

The Pleistocene deposits are divided into the following stratigraphic units, in order of decreasing age: Saskatchewan gravels, Wolf Island sediments, Elkwater drift, Cypress Hills loess, Wild Horse drift, Pakowki drift, Manyberries volcanic ash, Etzikom drift, and Oldman drift. The drift sheets are morphostratigraphic units, each one was deposited at the time of a significant glacial advance. Reliable correlation of subsurface tills with these surface drift sheets is presently not possible because of the sparse number of C-14 dates and limited number of known critical sedimentary parameters.

The Saskatchewan gravels are defined as those preglacial fluviatile sediments that floor the major preglacial valleys and cover the several alluvial terraces and benches below the Flaxville surface. They lie unconformably upon Upper Cretaceous rocks and are composed dominantly of quartzite pebbles. Wolf Island sediments consist of sands, silts and clays that accumulated in elongate proglacial lakes which formed along the preglacial valleys as a result of damming downstream by Laurentide ice. All the drift sheets were deposited by Laurentide glaciers.

Ages from late Tertiary to middle Pleistocene have been suggested for the Saskatchewan gravels by past workers. The presence of frost action structures and remains of Mammuthus primigenius definitely indicates a Pleistocene age for the lower (and younger) part. The Elkwater drift is regarded as post-Sangamon, pre-"classical" Wisconsin in age; all the younger drifts are considered to belong to the "classical" Wisconsin.

No severely weathered horizons have been observed between tills exposed along valley walls. However, two subsurface tills near Lethbridge are greater than 54,500 years old (Stalker, pers. comm., 1964), indicating that tills of early Wisconsin age or older are present in southern Alberta.

Location : AEU, SCI, TN 863. A33 15th 1965 Part 1
Areas : Map areas - 72 E
Borden areas - DO
Topics : Faunal remains - Mammuthus, Glacial chronology, Loess - heavy minerals, Loess - sedimentary characteristics, Quaternary stratigraphy, Tephra - Glacier Peak

f. Central and East-Central Alberta

Andriashek, L.D.

1983 Preliminary Report of the Surficial Geology and Quaternary Stratigraphy of Edmonton, Map Area NTS 83H, 1983. Research Council of Alberta Open File Report 1983-20. (17 pp.)

The continued expansion of the greater Edmonton area has placed more demand for not only geologic construction materials, but also a more detailed understanding of the regional surficial geology and the properties of the deposits as they relate to construction and engineering design. ... The primary objective of the study was to not only define the origin and history of the stratigraphic units, but to also provide a data base for land use planners ...

Abstract : Abbreviated from Author's Introduction
Location : ADTMP, QE 186. R4 O6 1983-20
ARC, Open File Report 1983-20
Areas : Map areas - 83 H
Borden areas - FP
Topics : Buried valleys, Drilling, Glacial chronology, Quaternary stratigraphy, Quaternary stratigraphy - Saskatchewan gravels and sands, Till - lithology, Till - mineralogy, Till - physical properties

Westgate, J.A., and L. Kalas, M.E. Evans

1976 Geology of the Edmonton Area, Alberta. Field Trip C-8: Guidebook, GAC/MAC Joint Annual Meeting, Edmonton, Alberta. (49 pp.)

Abstract : No abstract available
Location : AEU, SCI, QE 186. W528 1976
Areas : Map areas - 83 H
Borden areas - FP
Topics : Bedrock geology, Faunal remains, Faunal remains - Equus, Faunal remains - Mammuthus, Faunal remains - Titanotylopus, Field trip guide, Glacial chronology, Glacial lake sequences, Molluscs, Oxygen isotope studies, Palaeomagnetism, Periglacial features, Pollen analysis, Quaternary stratigraphy, Tephra -composition, Tephra - Mazama

g. Northern Alberta

Andriashek, L.D.

1984 Quaternary Stratigraphy of the Sand River Map Area. Part of Open File Report 1979-6. Research Council of Alberta, Edmonton. (228 pp. + Appendices).

Eight glacial and non-glacial formations have been defined for the entire Quaternary sequence in the Sand River area. The thick drift cover, combined with a paucity of exposures necessitates reliance on testhole data for the differentiation and correlation of these units. The stratigraphy of the upper 50 m is defined primarily from matrix texture and carbonate content, and 1-2 mm sand mineralogy data derived primarily from 1 m spaced dry auger samples. Rotary drill samples and electric log responses are essential to define the deeper stratigraphy.

The relative abundance of four rock groups (igneous and metamorphics, quartz, carbonates and local bedrock) within the 1-2 mm sand fraction is the most useful criteria in differentiating till units. The proportion of these rocks commonly show a systematic change with distance from the source, consequently a ratio of their abundance, rather than the absolute percentages, is used to differentiate the tills within a local sequence. The standardization of electric log responses with the analytical values enable correlations of the units beyond areas where samples were collected. Textural and lithologic variations allow the division of some formations into units or members.

The formations have been formally defined with designated type sections. The Empress Formation is the oldest unit. It is divided into three units on the basis of lithology: unit 1, preglacial sand and gravel, unit 2, silt and clay, and unit 3, glacial sand and gravel. The Bronson Lake Formation overlies the Empress Formation. It consists of clayey till and clay deposited by the first glacier in the area, the Cherry Grove Glacier. Glaciofluvial sand and gravel of the Muriel Lake Formation was deposited on top of the Bronson Lake Formation, following the retreat of the Cherry Grove Glacier, and during the advance of the Fort Kent Glacier. Till of the Bonnyville Formation overlies the Muriel Lake formation. It was deposited by the Fort Kent Glacier, and is characterized by a relative abundance of quartz, and a paucity of carbonate in the 1-2 mm sand fraction.

Glaciolacustrine silt and clay of the Ethel Lake Formation was deposited in proglacial lakes during the advance of the Ardmore Glacier. Till of Marie Creek Formation was deposited by the Ardmore Glacier, overtop the Ethel Lake Formation. The till is characterized by a relative abundance of carbonate rocks, mainly dolostone, in the silt-clay and 1-2 mm sand fraction.

Glaciofluvial sand of the Sand River Formation was deposited following the retreat of the Ardmore Glacier and during the advance of the Cold Lake Glacier.

The Grand Centre Formation consists of till and glacially displaced sediment deposited by the Cold Lake Glacier. The till is characterized by an abundance of igneous and metamorphic rock fragments in the 1-2 mm sand fraction.

Oxidized profiles on the surface of the till formations suggest that lengthy periods of weathering followed each major glacial episode.

Note : This report will soon be superseded by Research Council of Alberta Bulletin 57, in press (Andriashek, pers. comm. to ABB, 1989).
Location : ADTMP, QE 186. R4 O6 1979-6
ARC, Open File Report 1979-6
Areas : Map areas - 73 L
Borden areas - GO
Topics : Buried valleys, Drilling, Glacial chronology, Glacial lake sequences, Ice movement

indicators, Quaternary stratigraphy, Till - clay mineralogy, Till - lithology, Till - mineralogy, Till - physical properties

h. Northeastern British Columbia

Mathews, W.H.

1963 **Quaternary Stratigraphy and Geomorphology of the Fort St. John Area, Northeastern British Columbia. Report on file, British Columbia Department of Mines and Petroleum Resources, Victoria, British Columbia. (22 pp.)**

Unconsolidated sediments in the Fort St. John area include a twice repeated succession of gravel overlain by sand, silt, and clay, and each of these in turn by till of eastern origin. Both successions are interpreted as: (1) gravel laid down by Peace River during or at the close of interglacial (and preglacial?) intervals, (2) fine sediments laid down in lakes ponded in Peace River Valley by ice advancing from the east, and (3) till laid down after ice reached the Fort St. John area. The younger till [early Wisconsin(?)] is covered by sediments, chiefly clay, from a series of proglacial lakes, and by local postglacial deposits.

The topography of the uplands reflects the form of the stream-eroded Cretaceous bedrock, modified slightly by glacial erosion and by the deposition of a thin mantle of till. Landform at intermediate levels is determined largely by sediments which were deposited in proglacial lakes both preceding and following the last glaciation from the east. Since the draining of the last proglacial lake Peace River has cut a trench 700 feet deep below the lake floor and 150 to 250 feet below its interglacial channel.

Ice from the Cordilleran area reached to within 15 miles of Fort St. John, over-riding areas from which the early Wisconsin (?) eastern ice had already withdrawn.

The Quaternary history here is important in localizing the few available aquifers for shallow farm wells, and may have significantly influenced migration of early man into central North America.

Location : AEU, SCI, QE 697. M429
Areas : Map areas - 94 A, British Columbia - Northeastern
Borden areas - HR, region as above
Topics : Glacial chronology, Glacial geomorphology, Glacial lake sequences, Quaternary stratigraphy

Mathews, W.H.

1962 **Quaternary Geology, Peace River District, British Columbia. In Edmonton Geological Society, 4th Annual Field Trip Guidebook, Peace River, edited by E.E. Pelzer, pp. 1-4.**

Location : AEU, SCI, QE 1. E2422
Areas : Map areas - 94 A, 93 P, British Columbia - Northeastern
Borden areas - HR, GR, region as above
Topics : Buried valleys, Drilling, Field trip guide, Glacial chronology, Glacial lake sequences, Quaternary stratigraphy

PART 2. LATE QUATERNARY PALAEOENVIRONMENTS

a. General

Vance, R.E.

1986 **Late Quaternary Vegetation and Climate of the Eastern Slopes - the Record from Pollen Studies. In Eastern Slopes Prehistory: Selected Papers, edited by B.M. Ronaghan, pp. 247-267. Archaeological Survey of Alberta, Occasional Paper No. 30. Alberta Culture and Multiculturalism, Edmonton, Alberta.**

Location : AEU, GOVPUB, CA2 AL C431 O16 No. 030
AEA, HSS/ASA, 917.12303 Ea77
Areas : Map areas - 82 G, 82 H, 82 J, 82 N, 82 O, 83 L, 83 SW
Borden areas - DP, EP, EQ, FQ, GQ
Topics : Review of pollen studies, Review of vegetation history

b. Southern Western Corridor

Christiansen, O.A., and L.V. Hills
1971 Palynologic and Paleoclimatic Interpretation of Recent Sediments, Waterton Lakes National Park, Alberta. Report to National and Historic Parks Branch, Department of Indian Affairs and Northern Development, Ottawa. (13 pp.)

Location : ACIA
Areas : Map areas - 82 G, 82 H
Borden areas - DP
Topics : Plant macrofossils, Pollen analysis, Tephra - Mazama

Jackson, Jr., L.E., (editor)
1984 Quaternary Palynology, Extant Flora and Quaternary Geology South and West of Calgary. Field Excursion No. 1, Sixth International Palynological Conference, Calgary. (65 pp.)

Location : IC
Areas : Map areas - 82 J, 82 O
Borden areas - EP
Topics : Faunal remains, Field trip guide, Pollen analysis, Quaternary stratigraphy

c. Central Western Corridor

Delorme, L.D.
1986 Freshwater Ostracoda and Paleoenvironmental Interpretations from the Vermilion Lake Site (Core 119) Alberta. National Water Research Institute (NWRI) Unpublished Technical Note AED-86-3, Burlington, Ontario. (14 pp.)

Location : ACIA
Areas : Map areas - 82 O
Borden areas - EP
Topics : Ostracods

Delorme, L.D.
1986 Freshwater Ostracoda and Paleoenvironmental Interpretation from Copper Lake (Core 107), Alberta. National Water Research Institute (NWRI) Unpublished Technical Note AED-86-1, Burlington, Ontario. (12 pp.)

Location : ACIA
Areas : Map areas - 82 O
Borden areas - EP
Topics : Ostracods

King, R.H., A. Bowyer-Beaudoin, and F.J. Chorley
1981 Holocene Environmental Change in Jasper National Park: Fourth Interim Report. Progress Report submitted to Parks Canada. (26 pp.)

Location : Jasper National Park Library, Jasper
Areas : Map areas - 82 N, 83 C, 83 F
Borden areas - EQ, FQ
Topics : Pollen analysis, Soil - pedogenesis, Tephra - Bridge River, Tephra - Mazama, Tephra - St. Helens

King, R.H., K.B. Cawker, M.S. Kearney, A. Beaudoin and K. Holland
1980 Holocene Environmental Change in Jasper National Park: Third Interim Report. Progress Report submitted to Parks Canada. (37 pp.)

Location : Jasper National Park Library, Jasper
Areas : Map areas - 83 C, 83 D
Borden areas - FQ
Topics : Glacial chronology, Holocene timberline fluctuations, Palaeosols, Pollen analysis, Quaternary stratigraphy, Tephra - Bridge River, Tephra - Mazama, Tephra - St. Helens

Luckman, B.H., M.S. Kearney, A. Bowyer-Beaudoin and K. Holland
1979 Holocene Environmental Change in Jasper National Park: Second Interim Report. Progress Report submitted to Parks Canada. (29 pp.)

Location : Jasper National Park Library, Jasper
Areas : Map areas - 83 C, 83 D
Borden areas - FQ
Topics : Glacial chronology, Holocene timberline fluctuations, Pollen analysis, Quaternary stratigraphy

Luckman, B.H., M.S. Kearney, and K. Holland
1977 Holocene Environmental Change in Jasper National Park. Progress Report submitted to Parks Canada. (18 pp.)

Location : Jasper National Park Library, Jasper
Areas : Map areas - 83 C, 83 D
Borden areas - FQ
Topics : Dendrochronology, Glacial chronology, Pollen analysis, Tephra - Bridge River, Tephra - Mazama, Tephra - St. Helens

Schweger, C., T. Habgood, and M. Hickman
1981 Late Glacial-Holocene Climatic Changes of Alberta: the Record from Lake Sediment Studies. In The Impact of Climate Fluctuations on Alberta's Resources and Environment, compiled by K.R. Leggat and J.T. Kotylak, pp. 47-60. Proceedings of the Workshop and Annual Meeting of the Alberta Climatological Association, Report W.A.E.S.-1-81, A.E.S. Western Region, Environment Canada.

The detailed study of fossil pollen, fossil diatoms, and sediment chemistry of dated lake cores has provided an excellent paleoecological record from central Alberta. A later glacial-Holocene climatic picture is emerging. During glacial times cold xeric-adapted tundra vegetation developed in the unglaciated foothills of southern Alberta. This periglacial vegetation persisted into the late glacial and expanded northwards as ice recession continued. Rapid warming near 11,300 to 11,200 years B.P. resulted in widespread ice stagnation, and the rapid invasion of arboreal vegetation until boreal forest was established over central Alberta. This warming trend appears to have continued unabated into the early Holocene when drought and evaporation dropped lake levels and enabled prairie vegetation to expand northwards. We would suggest that the period of significant drought began approximately 9,000 B.P. and continued until 6,000 B.P. at which time some lake basins began to infill. The climate of central Alberta became significantly cooler or wetter around 4,000 B.P. and soon thereafter the modern vegetation and presumably modern climate became established.

Abstract : Authors' penultimate paragraph
Location : AEU, SCI, QC 851. A32 1981
AEPAA, 551.697123 L524
Areas : Map areas - 73 L, 83 C, 83 G, 83 H, 83 I, 83 L
Borden areas - EQ, FP, FQ, GO, GP
Topics : Diatoms, Pollen analysis, Sediments - chemistry, Tephra - Mazama, Vegetation history

White, J.

1988 Palaeoecological Research in Banff National Park. In Parks Canada Archaeology in Western Region, 1984, edited by D. Steer, pp. 16-17. Research Bulletin No. 264, Environment Canada, Canadian Parks Service.

Location : IC
Areas : Map areas - 82 O
Borden areas - EP
Topics : Archaeological sites - EhPv-8, Pollen analysis, Tephra - Bridge River, Tephra - Mazama

White, J.M.

1987 Late Pleistocene and Recent Environments of the Bow Valley, Banff National Park. Report to Parks Canada, Western Regional Office, Calgary. (49 pp.)

Location : ACIA
Areas : Map areas - 82 O
Borden areas - EP
Topics : Diatoms, Ostracods, Pollen analysis, Tephra - Bridge River, Tephra - Mazama

PART 3. LATE QUATERNARY PALAEONTOLOGY

a. Southeastern Alberta and Southern Saskatchewan

Russell, L.S., and C.S. Churcher
1972 Vertebrate Paleontology, Cretaceous to Recent, Interior Plains, Canada. XXIV International Geological Congress, Montreal, Excursion A21. (46 pp.)

Location : IC
Areas : Map areas - 72 E, 72 L, 82 O, 82 P, Saskatchewan - Wellsch Valley
Borden areas - DO, EO, EP, region as above
Topics : Faunal remains, Palaeontology, Quaternary stratigraphy

SECTION F. MAPS

PART 1. SURFICIAL GEOLOGY MAPS

a. General

Bayrock, L.A., and T.H. Reimchen
1980 Surficial Geology of the Alberta Foothills and Rocky Mountains. Scale 1:250,000, NTS Sheets: 83 B, 83 L, 83 F, 82 O, 82 J, 82 G, 82 H (Six Sheets with Legend Sheet). Alberta Geological Survey, Research Council of Alberta.

Location : UA, WCW, Alberta C-5:72
ARC, Surficial geology maps
Areas : Map areas - 82 G, 82 H, 82 J, 82 O, 83 B, 83 F, 83 L
Borden areas - DP, EP, EQ, FQ, GQ
Topics : Surficial geology maps

Reimchen, T.H., and L.A. Bayrock
1977 Surficial Geology and Erosion Potential of Rocky Mountains and the Foothills of Alberta. Scale 1:50,000, NTS Sheets: 226 maps as transparent overlays, one for each NTS 1:50,000 map sheet. Open File Report 1977-14. Alberta Geological Survey, Research Council of Alberta. (157 pp.)

Location : UA, WCW, Alberta C-5:72a (67 sheets available)
ARC, Open File Report 1977-14
Areas : Map areas - 82 G, 82 H, 82 I, 82 J, 82 N, 82 O, 83 B, 83 C, 83 D, 83 E, 83 F, 83 L
Borden areas - DP, EP, EQ, FP, FQ, GQ
Topics : Surficial geology maps

b. Southern Western Corridor

Bayrock, L.A., and J.F. Jones

1963 **Surficial Geology of the Vauxhall District. Scale 1:63,360, NTS Sheet: 82 I/1. Accompanies Earth Sciences Report 63-2, Alberta Geological Survey, Research Council of Alberta.**

Location : AEU, SCI, QE 186. P7 No. 63-002
UA, WCW, Alberta C-5:13/82I
AEPAA, 557.123 R311 63-2
ARC, Earth Sciences Report 63-2
Areas : Map areas - 82 I
Borden areas - DP
Topics : Surficial geology maps

Harrison, J.E.

1976 **Waterton Lakes National Park: Quaternary Geology. Scale 1:50,000, NTS Sheets: 82 G/1, 82 H/4, Geological Survey of Canada Map 1422A. Accompanies Geological Survey of Canada Miscellaneous Report 26.**

Location : AEU, SCI, QE 186. H32 1976
AEPAA, 551.79 H246
UA, WCW, GSC, Series A, 1422A
Areas : Map areas - 82 G, 82 H
Borden areas - DP
Topics : Surficial geology maps

Jackson, Jr., L.E.

1984 **Surficial Geology and Terrain Inventory of the Alberta Portion of the Kananaskis Lakes Map Area. Scale 1:125,000, NTS Sheet: 82 J. Geological Survey of Canada Preliminary Series Map 2-1984.**

Location : UA, WCW, GSC, Preliminary Series, 2-1984
Areas : Map areas - 82 J
Borden areas - EP
Topics : Surficial geology maps

Shetsen, I.

1987 **Quaternary Geology, Southern Alberta. Scale 1:500,000, NTS Sheets: 72 E, 72 L, 72 M, 82 H, 82 I, 82 J, 82 O, 82 P (Part of Sheet). Research Council of Alberta.**

Location : ARC, Surficial geology maps
UA, WCW, Alberta C-5:80
Areas : Map areas - 72 E, 72 L, 72 M, 82 H, 82 NE
Borden areas - DO, DP, EO, EP
Topics : Surficial geology maps

Shetsen, I.
1981 Surficial Geology, Lethbridge, Alberta. Scale 1: 250,000, NTS Sheets: 82 H and part of 82 I. Research Council of Alberta.

Location : UA, WCW, Alberta C-5:13/82H
Areas : Map areas - 82 H, 82 I
Borden areas - DP, EP
Topics : Surficial geology maps

Stalker, A. MacS.
1974 Kananaskis Research Forest-Marmot Creek. Scale 1:50,000, NTS Sheets: 82 J/14, 82 J/15, 82 O/2, 82 O/3. Geological Survey of Canada Map 1365A. Accompanies Geological Survey of Canada Paper 72-51.

Location : AEU, SCI, QE 185. C2
AEPAA, 557.1 C16 P72-51
UA, WCW, GSC, Series A, 1365A
Areas : Map areas - 82 J, 82 O
Borden areas - EP
Topics : Surficial geology maps

Stalker, A. MacS.
1965 Bassano. Scale 1:253,440, NTS Sheets: 82 I/1, 82 I/2, 82 I/7, 82 I/8, 82 I/9, 82 I/10, 82 I/15, 82 I/16. Geological Survey of Canada Map 5-1965.

Location : UA, WCW, GSC, Preliminary Series, 5-1965
Areas : Map areas - 82 I
Borden areas - EP
Topics : Surficial geology maps

Stalker, A. MacS.
1963 Blood Indian Reserve. Scale 1:126,720, NTS Sheet: Part of Sheet 82H. Geological Survey of Canada Map 40-1963. Accompanies Geological Survey of Canada Paper 63-25.

Location : AEU, SCI, QE 185. C2
UA, WCW, GSC, Preliminary Series, 40-1963
Areas : Map areas - 82 H
Borden areas - DP
Topics : Surficial geology maps

Stalker, A. MacS.
1962 Fernie (East Half). Scale 1:253,440, NTS Sheets: 82 G/1, 82 G/2, 82 G/7, 82 G/8, 82 G/9, 82 G/10, 82 G/15, 82 G/16. Geological Survey of Canada Map 31-1961.

Location : UA, WCW, GSC, Preliminary Series, 31-1961

Areas : Map areas - 82 G
Borden areas - DP
Topics : Surficial geology maps

Stalker, A. MacS.
1962 Lethbridge (East Half). Scale 1:253,440, NTS Sheet: 82 H (East Half). Geological Survey of Canada Map 41-1962.

Location : UA, WCW, GSC, Preliminary Series, 41-1962
Areas : Map areas - 82 H
Borden areas - DP
Topics : Surficial geology maps

Stalker, A. MacS.
1959 Fort Macleod. Scale 1:253,440, NTS Sheet: 82 H (West Half). Geological Survey of Canada Map 21-1958.

Location : UA, WCW, GSC, Preliminary Series, 21-1958
Areas : Map areas - 82 H
Borden areas - DP
Topics : Surficial geology maps

Stalker, A. MacS.
1957 High River. Scale 1:253,440, NTS Sheet: 82 I. Geological Survey of Canada Map 14-1957.

Location : UA, WCW, GSC, Preliminary Series, 14-1957
Areas : Map areas - 82 I
Borden areas - EP
Topics : Surficial geology maps

N.A.
1970 South Saskatchewan River Basin Study: Surficial Deposits and Groundwater Yields. Scale 1:1,172,160, NTS Sheets 72 E, 72 L, part of 72 M, 82 G, 82 H, 82 I, 82 J, parts of 82 O and 82 P. Water Resources Division, Department of Agriculture, Alberta.

Location : UA, WCW, Alberta C-5:14
Areas : Map areas - 72 E, 72 L, 72 M, 82 G, 82 H, 82 NE
Borden areas - DO, DP, EO, EP
Topics : Surficial geology maps

N.A.

n.d. Blood Indian Reserve Timber Limit, Alberta, Surficial Geology. Scale approx. 1:21,000, NTS Sheet 82 H/4. Surficial formations taken from GSC Map No. 40-1963.

Location : UA, WCW, UA, WCW, C-5:68
Areas : Map areas - 82 H
Borden areas - DP
Topics : Surficial geology maps

c. Central Western Corridor

Boydell, A.N., L.A. Bayrock, and T.H. Reimchen
1974 Surficial Geology of the Rocky Mountain House Area. Scale 1:250,000, NTS Sheet: 83 B. Alberta Geological Survey, Research Council of Alberta.

Location : ARC, Surficial geology maps
UA, WCW, Alberta C-5:13/83B
Areas : Map areas - 83 B
Borden areas - FP
Topics : Surficial geology maps

Moran, S.R.
1986 Surface Materials of the Calgary Urban Area: Dalemead Sheet. Scale 1:50,000, NTS Sheet: 82 I/13. Accompanies Research Council of Alberta Bulletin 53. (46 pp.)

Location : ARC, Bulletin 53
UA, WCW, Alberta C-5:13/82I/13
Areas : Map areas - 82 I
Borden areas - EP
Topics : Surficial geology maps

Moran, S.R.
1986 Surface Materials of the Calgary Urban Area: Dalroy Sheet. Scale 1:50,000, NTS Sheet: 82 P/4. Accompanies Research Council of Alberta Bulletin 53. (46 pp.)

Location : ARC, Bulletin 53
UA, WCW, Alberta C-5:13/82P/4
Areas : Map areas - 82 P
Borden areas - EP
Topics : Surficial geology maps

Moran, S.R.
1986 Surface Materials of the Calgary Urban Area: Priddis Sheet. Scale 1:50,000, NTS Sheet: 82 J/16. Accompanies Research Council of Alberta Bulletin 53. (46 pp.)

Location : ARC, Bulletin 53
UA, WCW, Alberta C-5:13/82J/16
Areas : Map areas - 82 J
Borden areas - EP
Topics : Surficial geology maps

Moran, S.R.

1986 Surface Materials of the Calgary Urban Area: Calgary Sheet. Scale 1:50,000, NTS Sheet: 82 O/1. Accompanies Research Council of Alberta Bulletin 53. (46 pp.)

Location : ARC, Bulletin 53
UA, WCW, Alberta C-5:13/82O/1
Areas : Map areas - 82 O
Borden areas - EP
Topics : Surficial geology maps

Roed, M.A.

1970 Surficial Geology, Edson, Alberta. Scale 1:250,000, NTS Sheet: Part of 83 F. Alberta Geological Survey, Research Council of Alberta.

Location : UA, WCW, Alberta C-5:13/83F
ARC, Surficial geology maps
Areas : Map areas - 83 F
Borden areas - FQ
Topics : Surficial geology maps

Rutter, N.W.

1972 Surficial Geology, Banff Area. Scale 1:50,000, NTS Sheets: 82 J/13, 82 J/14, 82 O/3, 82 O/4, 82 O/5, 82 O/6, 82 N/1, 82 N/8. Geological Survey of Canada Map 1324A, Sheets 1 and 2. Accompanies Geological Survey of Canada Bulletin 206.

Location : AEU, SCI, QE 185. A43 No. 206
AEPAA, 557.1 C166 206
UA, WCW, GSC, Series A, 1324A
Areas : Map areas - 82 J, 82 N, 82 O
Borden areas - EP
Topics : Surficial geology maps

Rutter, N.W.

1972 Relative Ages of Surficial Deposits, Banff Area. Scale 1:125,000, NTS Sheets: 82 O/3, 82 O/4, 82 O/5, 82 O/6, 82 N/1, 82 N/8. Geological Survey of Canada Map 1325A, Sheets 1 and 2. Accompanies Geological Survey of Canada Bulletin 206.

Location : AEU, SCI, QE 185. A43 No. 206
AEPAA, 557.1 C166 206
UA, WCW, GSC, Series A, 1325A
Areas : Map areas - 82 N, 82 O
Borden areas - EP
Topics : Surficial geology maps

Stalker, A. MacS.

1956 **__Beiseker__. Scale 1:126,720, NTS Sheet: 82 P. Geological Survey of Canada Map 55-7.**

Location : UA, WCW, GSC, Paper 55-7
AEPAA, 557.1 C16P 55-7
Areas : Map areas - 82 P
Borden areas - EP
Topics : Surficial geology maps

d. Northern Western Corridor

Andriashek, L.D.
1983 Surficial Geology of the Wapiti Map Area. Scale 1:250,000, NTS Sheet: 83 L. Open File Report 1983-23, Alberta Geological Survey, Research Council of Alberta. (4 pp.)

Note : Map accompanies report
Location : ARC, Open file report 1983-23
Areas : Map areas - 83 L
Borden areas - GQ
Topics : Surficial geology maps

Fox, J.C., R.J.H. Richardson, R. Gowan, and P.C. Sham
1987 Surficial Geology of the Peace River-High Level Area, Alberta. Scale 1:500,000. Alberta Geological Survey, Research Council of Alberta.

Location : ARC, Surficial geology maps
UA, WCW, Alberta C-5:81
Areas : Map areas - 84 C, 84 K
Borden areas - HQ, IQ
Topics : Surficial geology maps

Henderson, E.P.
1960 Sturgeon Lake. Scale 1:253,440, NTS Sheet: 83 N (West Half). Geological Survey of Canada Map 1077A. Accompanies Geological Survey of Canada Memoir 303.

Location : AEU, SCI, QE 185. A2
AEPAA, 557.1 C16 303
UA, WCW, GSC, Series A, 1077A
UA, WCW, GSC Memoir 303, Serials No. 2250
Areas : Map areas - 83 N
Borden areas - GQ
Topics : Surficial geology maps

Jones, J.F.
1966 Surficial Deposits of the Peace River District, Alberta. Scale 1:506,880, NTS Sheets: 83 M, 83 N, 84 C, 84 D. Accompanies Bulletin 16, Alberta Geological Survey, Research Council of Alberta.

Location : AEU, SCI, QE 186. R415 No. 16
AEPAA, 553.79 J718
ARC, Bulletin 16
UA, WCW, Alberta Research Council Bulletin 16, Serials
UA, WCW, Alberta C-5:13
Areas : Map areas - 83 M, 83 N, 84 C, 84 D
Borden areas - GQ, HQ

Topics : Surficial geology maps

St-Onge, D.A.
1967 Iosegun Lake (East Half) Surficial Geology. Scale 1:253,440, NTS Sheets: 83 K/1, 83 K/2, 83 K/7, 83 K/8, 83 K/9, 83 K/10, 83 K/15, 83 K/16. Geological Survey of Canada Map 15-1966.

Location : UA, WCW, GSC Preliminary Series 15-1966
Areas : Map areas - 83 K
Borden areas - GQ
Topics : Surficial geology maps

e. Southeastern Alberta and Southern Saskatchewan

Berg, T., and R.A. McPherson

1972 Surficial Geology of the Medicine Hat Area, Alberta. Scale 1:250,000, NTS Sheet: 72 L. Alberta Geological Survey, Research Council of Alberta.

Location : UA, WCW, Alberta C-5:13/72L
ARC, Surficial geology maps
Areas : Map areas - 72 E
Borden areas - EO
Topics : Surficial geology maps

Westgate, J.A.

1968 Surficial Geology of the Foremost-Cypress Hills Area, Alberta. Scale 1:250,000, NTS Sheet: 72 E. Accompanies Bulletin 22, Alberta Geological Survey, Research Council of Alberta.

Location : AEU, SCI, QE 186. R415 No. 22
UA, WCW, Alberta C-5:13/72E
AEPAA, 557.1234 W5265
ADTMP, QE 186. R4 22
ARC, Bulletin 22
Areas : Map areas - 72 E
Borden areas - DO
Topics : Surficial geology maps

Westgate, J.A.

1965 Surficial Geology of the Cypress Hills Area, Alberta. Scale 1:63,360, NTS Sheet: 72 E. Accompanies Earth Sciences Report 65-2, Alberta Geological Survey, Research Council of Alberta.

Location : AEU, SCI, QE 186. P7 No. 65-002
UA, WCW, Alberta Research Council, Report 65-2, Serials
AEPAA, 557.123 R311 65-2
ARC, Earth Sciences Report 65-2
Areas : Map areas - 72 E
Borden areas - DO
Topics : Surficial geology maps

f. Central and East-Central Alberta

Andriashek, L.D., M.M. Fenton, and J.D. Root
1979 **Surficial Geology of the Wabamun Lake Area. Scale 1:250,000, NTS Sheet: 83 G. Alberta Geological Survey, Research Council of Alberta.**

Location : UA, WCW, Alberta C-5:13/83G
ARC, Surficial geology maps
Areas : Map areas - 83 G
Borden areas - FP
Topics : Surficial geology maps

Andriashek, L.
1983 **Preliminary Report of the Surficial Geology and Quaternary Stratigraphy of the Edmonton Map Area. NTS Sheet: 83 H. Open File Report 1983-20, Alberta Geological Survey, Research Council of Alberta. (17 pp.)**

Note : Maps accompany report
Location : ARC, Open file report 1983-20
Areas : Map areas - 83 H
Borden areas - FP
Topics : Surficial geology maps

Bayrock, L.A.
1972 **Surficial Geology of the Edmonton Area. Scale 1:250,000, NTS Sheet: 83 H. Accompanies Earth Sciences Report 73-2, Alberta Geological Survey, Research Council of Alberta.**

Location : ARC, Earth Sciences Report 73-2
UA, WCW, C-5:13/83H
Areas : Map areas - 83 H
Borden areas - FP
Topics : Surficial geology maps

Bayrock, L.A.
1967 **Surficial Geology, Bodo District, Alberta. Scale 1:63,360, NTS Sheet: 73 D (East Half), Map 67-4A. Accompanies Earth Sciences Report 67-4, Alberta Geological Survey, Research Council of Alberta. (10 pp.)**

Location : AEU, SCI, QE 186. P7 No. 67-004
ARC, Earth Sciences Report 67-4
UA, WCW, C-5:13/73D/1
Areas : Map areas - 73 D
Borden areas - FO
Topics : Surficial geology maps

Bayrock, L.A.

1967 Surficial Geology, Neutral Hills District, Alberta. Scale 1:63,360, NTS Sheet: 73 D (East Half), Map 67-4B. Accompanies Earth Sciences Report 67-4, Alberta Geological Survey, Research Council of Alberta. (10 pp.)

Location : AEU, SCI, QE 186. P7 No. 67-004
UA, WCW, Alberta C-5:13/73D/2
UA, WCW, Alberta Research Council, Report 67-4, Serials
ARC, Earth Sciences Report 67-4
Areas : Map areas - 73 D
Borden areas - FO
Topics : Surficial geology maps

Bayrock, L.A.

1967 Surficial Geology, Czar District, Alberta. Scale 1:63,360, NTS Sheet: 73 D (East Half), Map 67-4C. Accompanies Earth Sciences Report 67-4, Alberta Geological Survey, Research Council of Alberta. (10 pp.)

Location : AEU, SCI, QE 186. P7 No. 67-004
ARC, Earth Sciences Report 67-4
UA, WCW, C-5:13/73D/7
UA, WCW, Alberta Research Council, Report 67-4, Serials
Areas : Map areas - 73 D
Borden areas - FO
Topics : Surficial geology maps

Bayrock, L.A.

1967 Surficial Geology, Provost District, Alberta. Scale 1:63,360, NTS Sheet: 73 D (East Half), Map 67-4D. Accompanies Earth Sciences Report 67-4, Alberta Geological Survey, Research Council of Alberta. (10 pp.)

Location : AEU, SCI, QE 186. P7 No. 67-004
ARC, Earth Sciences Report 67-4
UA, WCW, Alberta Research Council, Report 67-4, Serials
UA, WCW, Alberta C-5:13/73D/8
Areas : Map areas - 73 D
Borden areas - FO
Topics : Surficial geology maps

Bayrock, L.A.

1967 Surficial Geology, Chauvin District, Alberta. Scale 1:63,360, NTS Sheet: 73 D (East Half), Map 67-4E. Accompanies Earth Sciences Report 67-4, Alberta Geological Survey, Research Council of Alberta. (10 pp.)

Location : AEU, SCI, QE 186. P7 No. 67-004
ARC, Earth Sciences Report 67-4
UA, WCW, Alberta C-5:13/73D/9
UA, WCW, Alberta Research Council, Report 67-4, Serials

Areas : Map areas - 73 D
Borden areas - FO
Topics : Surficial geology maps

Bayrock, L.A.
1967 Surficial Geology, Buffalo View District, Alberta. Scale 1:63,360, NTS Sheet: 73 D (East Half), Map 67-4F. Accompanies Earth Sciences Report 67-4, Alberta Geological Survey, Research Council of Alberta. (10 pp.)

Location : AEU, SCI, QE 186. P7 No. 67-004
ARC, Earth Sciences Report 67-4
UA, WCW, Alberta C-5:13/73D/10
UA, WCW, Alberta Research Council, Report 67-4, Serials
Areas : Map areas - 73 D
Borden areas - FO
Topics : Surficial geology maps

Bayrock, L.A.
1967 Surficial Geology, Wainwright District, Alberta. Scale 1:63,360, NTS Sheet: 73 D (East Half), Map 67-4G. Accompanies Earth Sciences Report 67-4, Alberta Geological Survey, Research Council of Alberta. (10 pp.)

Location : AEU, SCI, QE 186. P7 No. 67-004
ARC, Earth Sciences Report 67-4
UA, WCW, C-5:13/73D/15
UA, WCW, Alberta Research Council, Report 67-4, Serials
Areas : Map areas - 73 D
Borden areas - FO
Topics : Surficial geology maps

Bayrock, L.A.
1967 Surficial Geology, McLaughlin District, Alberta. Scale 1:63,360, NTS Sheet: 73 D (East Half), Map 67-4H. Accompanies Earth Sciences Report 67-4, Alberta Geological Survey, Research Council of Alberta.

Location : AEU, SCI, QE 186. P7 No. 67-004
ARC, Earth Sciences Report 67-4
UA, WCW, C-5:13/73D/16
UA, WCW, Alberta Research Council, Report 67-4, Serials
Areas : Map areas - 73 D
Borden areas - FO
Topics : Surficial geology maps

Bayrock, L.A.

1958 **Glacial Geology, Galahad District, Alberta. Scale 1:63,360, NTS Sheet: 73 D/12, Map 57-3A. Accompanies Earth Sciences Report 57-3, Alberta Geological Survey, Research Council of Alberta. (35 pp.)**

Location : AEU, SCI, QE 186. P7 No. 57-003
ARC, Earth Sciences Report 57-3
UA, WCW, Alberta C-5:13/73D/12
UA, WCW, Alberta Research Council, Report 57-3, Serials
Areas : Map areas - 73 D
Borden areas - FO
Topics : Surficial geology maps

Bayrock, L.A.

1958 **Glacial Geology, Hardisty District, Alberta. Scale 1:63,360, NTS Sheet: 73 D/11, Map 57-3B. Accompanies Earth Sciences Report 57-3, Alberta Geological Survey, Research Council of Alberta. (35 pp.)**

Location : AEU, SCI, QE 186. P7 No. 57-003
ARC, Earth Sciences Report 57-3
UA, WCW, Alberta C-5:13/73D/11
UA, WCW, Alberta Research Council, Report 57-3, Serials
Areas : Map areas - 73 D
Borden areas - FO
Topics : Surficial geology maps

Bayrock, L.A.

1958 **Glacial Geology, Alliance District, Alberta. Scale 1:63,360, NTS Sheet: 73 D/5, Map 57-2A. Accompanies Earth Sciences Report 57-2, Alberta Geological Survey, Research Council of Alberta.**

Location : AEU, SCI, QE 186. P7 No. 57-002
ARC, Earth Sciences Report 57-2
UA, WCW, Alberta C-5:13/73D/5
UA, WCW, Alberta Research Council, Report 57-2, Serials
Areas : Map areas - 73 D
Borden areas - FO
Topics : Surficial geology maps

Bayrock, L.A.

1958 **Glacial Geology, Brownfield District, Alberta. Scale 1:63,360, NTS Sheet: 73 D/6, Map 57-2B. Accompanies Earth Sciences Report 57-2, Alberta Geological Survey, Research Council of Alberta.**

Location : AEU, SCI, QE 186. P7 No. 57-002
ARC, Earth Sciences Report 57-2
UA, WCW, Alberta C-5:13/73D/6
UA, WCW, Alberta Research Council, Report 57-2, Serials
Areas : Map areas - 73 D

Borden areas - FO
Topics: Surficial geology maps

Bayrock, L.A., and G.M. Hughes
1962 Surficial Geology of the Edmonton District, Alberta. Scale 1:63,360, NTS Sheet: 83 H. Four maps to accompany Earth Sciences Report 62-6, Alberta Geological Survey, Research Council of Alberta.

Location: AEU, SCI, QE 186. P7 No. 62-006
UA, WCW, Alberta C-5:13/83H/5, 83H/6, 83H/11, 83H/12
UA, WCW, Alberta Research Council, Report 62-6, Serials
AEPAA, 557.123 R311 62-6
ARC, Earth Sciences report 62-6
Areas: Map areas - 83 H
Borden areas - FP
Topics: Surficial geology maps

Collins, G.A., and A.G. Swan
1955 Glacial Geology, St. Ann Area, Alberta. Scale 1:253,440, NTS Sheet: 83 G. Accompanies Report 67, Alberta Geological Survey, Research Council of Alberta. (18 pp.)

Location: AEPAA, 551.314 C693
UA, WCW, Alberta C-5:13/83G/5 to 12 and parts of 13 to 16
ARC, Uncategorized Report 67
Areas: Map areas - 83 G
Borden areas - FP
Topics: Surficial geology maps

Craig, B.G.
1957 Drumheller. Scale 1:253,440, NTS Sheet: 82 P. Geological Survey of Canada Map 13-1957.

Location: UA, WCW, GSC Preliminary Series, 13-1957
AEPAA, 557.1233 C844
Areas: Map areas - 82 P
Borden areas - EP
Topics: Surficial geology maps

Gravenor, C.P.
1956 Glacial Geology, Castor District, Alberta. Scale 1:63,360, NTS Sheet: 73 D/4, Map 56-2. Accompanies Earth Sciences Report 56-2, Alberta Geological Survey, Research Council of Alberta. (23 pp.)

Location: AEU, SCI, QE 186. P7 No. 56-002
UA, WCW, Alberta C-5:13/73D/4
UA, WCW, Alberta Research Council, Report 56-2, Serials

ARC, Earth Sciences Report 56-2
Areas : Map areas - 73 D
Borden areas - FO
Topics : Surficial geology maps

Gravenor, C.P., and L.A. Bayrock
1955 Glacial Geology, Coronation District, Alberta. Scale 1:63,360, NTS Sheet: 73 D/3 and Part of 73 D/4, Map 55-1. Accompanies Earth Sciences Report 55-1, Alberta Geological Survey, Research Council of Alberta. (38 pp.)

Location : AEU, SCI, QE 186. P7 No. 55-001
UA, WCW, Alberta C-5:13/73D/3
UA, WCW, Alberta Research Council, Report 55-1, Serials
ARC, Earth Sciences Report 55-1
Areas : Map areas - 73 D
Borden areas - FO
Topics : Surficial geology maps

Gravenor, C.P., and R.B. Ellwood
1957 Glacial Geology, Sedgewick District, Alberta. Scale 1:63,360, NTS Sheet: 73 D/13, Map 57-1A. Accompanies Earth Sciences Report 57-1, Alberta Geological Survey, Research Council of Alberta.

Location : AEU, SCI, QE 186. P7 No. 57-001
UA, WCW, Alberta C-5:13/73D/13
UA, WCW, Alberta Research Council, Report 57-1, Serials
ARC, Earth Sciences Report 57-1
Areas : Map areas - 73 D
Borden areas - FO
Topics : Surficial geology maps

Gravenor, C.P., and R.B. Ellwood
1957 Glacial Geology, Sedgewick District, Alberta. Scale 1:63,360, NTS Sheet: 73 D/14, Map 57-1B. Accompanies Earth Sciences Report 57-1, Alberta Geological Survey, Research Council of Alberta.

Location : AEU, SCI, QE 186. P7 No. 57-001
UA, WCW, Alberta C-5:13/73D/14
UA, WCW, Alberta Research Council, Report 57-1, Serials
ARC, Earth Sciences Report 57-1
Areas : Map areas - 73 D
Borden areas - FO
Topics : Surficial geology maps

Kathol, C.P., and R.A. McPherson

1975 Surficial Geology of the Edmonton Area. Scale 1:50,000, NTS Sheet: 83 H. Accompanies Bulletin 32 as Figure 23, Alberta Geological Survey, Research Council of Alberta.

Note : This report contains a variety of other diagrams which may also be found useful. Among the more relevant are:
Fig. 24: Thickness of surficial deposits in the Edmonton area
Fig. 27: Thickness of Saskatchewan gravels and sands and overburden in the Edmonton area
Fig. 28: Thickness of glacial till in the Edmonton area
Fig. 29: Thickness of glaciolacustrine sediments in the Edmonton area
All of these can be found in the William C. Wonders Map Collection (UA, WCW).
Location : AEPAA, 557.1233 K156
ADTMP, QE 186. R4 B8 32
ARC, Bulletin 32
UA, WCW, Alberta C-5:13/83H/5,6,11,12
UA, WCW, Alberta Research Council, Bulletin 32, Serials
Areas : Map areas - 83 H
Borden areas - FP
Topics : Surficial geology maps

Stalker, A. MacS.

1973 Surficial Geology of Drumheller Area, Alberta. Scale 1:250,000, NTS Sheet: 82 P. Geological Survey of Canada Map 1336A. Accompanies Geological Survey of Canada Memoir 370.

Location : AEU, SCI, QE 185. A2 No. 370
UA, WCW, GSC, Series A, 1336A
AEPAA, 557.1 C16 370
Areas : Map areas - 82 P
Borden areas - EP
Topics : Surficial geology maps

Stalker, A. MacS.

1960 Surficial Geology, Red Deer-Stettler. Scale 1:253,440, NTS Sheet: 83A. Geological Survey of Canada Map 1081A. Accompanies Geological Survey of Canada Memoir 306.

Location : AEU, SCI, QE 185. A2 No. 306
UA, WCW, GSC, Series A, 1081A
AEPAA, 557.1 C16 306
Areas : Map areas - 83 A
Borden areas - FP
Topics : Surficial geology maps

g. Northern Alberta

Bayrock, L.A.
1972 Surficial Geology of the Peace Point and Fitzgerald Map Areas, Alberta. Scale 1:250,000, NTS Sheets: 74 M and 84 P. Alberta Geological Survey, Research Council of Alberta.

Location : ARC, Surficial geology maps
UA, WCW, Alberta C-5:13/74M, 84P
Areas : Map areas - 74 M, 84 P
Borden areas - IO, IP
Topics : Surficial geology maps

Bayrock, L.A.
1972 Surficial Geology of the Lake Claire Map Area, Alberta. Scale 1:250,000, NTS Sheet: 84 I. Alberta Geological Survey, Research Council of Alberta.

Location : ARC, Surficial geology maps
UA, WCW, Alberta C-5:13/84I
Areas : Map areas - 84 I
Borden areas - IP
Topics : Surficial geology maps

Bayrock, L.A.
1972 Surficial Geology of the Fort Chipewyan Area, Alberta. Scale 1:250,000, NTS Sheet: 74 L. Alberta Geological Survey, Research Council of Alberta.

Location : ARC, Surficial geology maps
UA, WCW, Alberta C-5:13/74L
Areas : Map areas - 74 L
Borden areas - IO
Topics : Surficial geology maps

Bayrock, L.A.
1971 Surficial Geology of the Bitumount Area. Scale 1:250,000, NTS Sheet: 74 E. Alberta Geological Survey, Research Council of Alberta.

Location : ARC, Surficial geology maps
UA, WCW, Alberta C-5:13/74E
Areas : Map areas - 74 E
Borden areas - HO
Topics : Surficial geology maps

Bayrock, L.A., and T.H. Reimchen

1974 Surficial Geology of the Waterways Area, Alberta. Scale 1:250,000, NTS Sheet: 74 D. Alberta Geological Survey, Research Council of Alberta.

Location : ARC, Surficial geology maps
UA, WCW, Alberta C-5:13/74D
Areas : Map areas - 74 D
Borden areas - HO
Topics : Surficial geology maps

Fenton, M.M., and L.D. Andriashek

1984 Surficial Geology of the Sand River Area, Alberta. Scale 1:250,000, NTS Sheet: 73 L. Alberta Geological Survey, Research Council of Alberta.

Location : ARC, Surficial geology maps
UA, WCW, Alberta C-5:13/73L
Areas : Map areas - 73 L
Borden areas - GO
Topics : Surficial geology maps

Kathol, C.P., and R.A. McPherson

1974 Surficial Geology of the House Mountain Area, Alberta. Scale 1:50,000, NTS Sheet: 83 O. Alberta Geological Survey, Research Council of Alberta.

Note : Map accompanies Research Council of Alberta Earth Sciences Report 74-5.
Location : ARC, Surficial geology maps
Areas : Map areas - 83 O
Borden areas - GP
Topics : Surficial geology maps

St-Onge, D.A., and S.H. Richard

1975 Whitecourt. Scale 1:250,000, NTS Sheet: 83 J. Geological Survey of Canada Map 1367A.

Location : UA, WCW, GSC, Series A, 1367A
Areas : Map areas - 83 J
Borden areas - GP
Topics : Surficial geology maps

N.A.

n.d. AOSERP Study Area - Surficial Geology. Scale 1:50,000, parts of NTS Sheets 74 D, 74 E, 9 sheets. Alberta Oil Sands Environmental Research Project (AOSERP), Alberta Environment, Edmonton, Alberta.

Notes : Information mapped includes surficial geology and landforms. For more information see Perrin (1985:206).
Location : UA, WCW, Alberta C-5:13, filed by NTS Sheet number

Areas: Map areas - 74 D, 74 E
Borden areas - HO
Topics: Surficial geology maps

PART 2. MAPS AND CHARTS DEALING WITH OTHER TOPICS: GEOMORPHOLOGY, STRATIGRAPHY, ICE LIMITS AND BIOPHYSICAL ZONES

a. General

Dyke, A.S., and V.K. Prest
1987 Late Wisconsinian and Holocene Retreat of the Laurentide Ice Sheet. Scale 1: 5 000 000. Geological Survey of Canada Map 1702A.

Note : Maps accompany paper by Dyke and Prest (1987)
Location : AEU, PMC, G 1. R452
UA, WCW, Canada C-121
Areas : Map areas - All Canada
Borden areas - All Canada
Topics : Glaciation maps

Dyke, A.S., and V.K. Prest
1987 Paleogeography of Northern North America, 18 000 - 12 000 Years Ago. Scale 1:12 500 000. Geological Survey of Canada Map 1703A. Sheet 1 of 3.

Note : Maps accompany paper by Dyke and Prest (1987)
Location : AEU, PMC, G 1. R452
UA, WCW, Canada C-122 1/3
Areas : Map areas - All Canada
Borden areas - All Canada
Topics : Glaciation maps

Dyke, A.S., and V.K. Prest
1987 Paleogeography of Northern North America, 11 000 - 8 400 Years Ago. Scale 1:12 500 000. Geological Survey of Canada Map 1703A. Sheet 2 of 3.

Note : Maps accompany paper by Dyke and Prest (1987)
Location : AEU, PMC, G 1. R452
UA, WCW, Canada C-122 2/3
Areas : Map areas - All Canada
Borden areas - All Canada
Topics : Glaciation maps

Dyke, A.S., and V.K. Prest
1987 Paleogeography of Northern North America, 8 000 - 5 000 Years Ago. Scale 1:12 500 000. Geological Survey of Canada Map 1703A. Sheet 3 of 3.

Note : Maps accompany paper by Dyke and Prest (1987)
Location : AEU, PMC, G 1. R452
UA, WCW, Canada C-122 3/3
Areas : Map areas - All Canada

Borden areas - All Canada
Topics: Glaciation maps

Prest, V.K.
1984 Late Wisconsinan Glacier Complex. Scale 1:7 500 000. Geological Survey of Canada Map 1584A.

Note: Map accompanies Geological Survey of Canada Paper 84-10
Location: AEU, SCI, QE 185. C2
UA, WCW, GSC, Series A, 1584A
AEPAA, 557.1 C16P 84-10
ARC, Contribution Series 1284
Areas: Map areas - All Canada
Borden areas - All Canada
Topics: Glaciation maps

Prest, V.K.
1969 Retreat of Wisconsin and Recent Ice in North America. Scale 1:5,000,000. Geological Survey of Canada Map 1257A.

Location: UA, WCW, GSC, Series A, 1257A
Areas: Map areas - All Canada
Borden areas - All Canada
Topics: Glaciation maps

Prest, V.K., D.R. Grant and V.N. Rampton
1968 Glacial Map of Canada. Scale 1:5,000,000. Geological Survey of Canada Map 1253A.

Location: UA, WCW, GSC, Series A, 1253A
Areas: Map areas - All Canada
Borden areas - All Canada
Topics: Glaciation maps

N.A.
1961-1979 Special Geomorphic Landform Maps. Scale 1:63,360. Resource Evaluation and Planning Division, Alberta Energy and Natural Resources, Edmonton, Alberta.

Note: Entire series consists of 326 maps, confined to northern Alberta, from 53°N northwards. See Perrin (1985:194) for more details.
Location: UA, WCW, C-series, 22 sheets available
Areas: Map areas - Alberta - Northern
Borden areas - Alberta - Northern
Topics: Geomorphological maps

b. Central Western Corridor

Shetsen, I.

1981 Sand and Gravel Resources of the Calgary Area. Scale 1:50,000, NTS Sheets: parts of 82 I, 82 J, 82 O, and 82 P, 22 sheets. Accompanies Research Council of Alberta, Open File Report 1981-8.

Notes : Includes some information on surficial deposits. Similar maps and open file reports are available for other areas of Alberta. For complete list and more details see Perrin (1985:215) and Alberta Research Council (1986).
Location : ARC, Open File Report 1981-8
UA, WCW, C-5:13/82O
Areas : Map areas - 82 NE
Borden areas - EP
Topics : Sand and gravel resource maps

N.A.

1981 Ecological (Biophysical) Land Classification of Banff and Jasper National Parks, Alberta. Scale 1:50,000, NTS Sheets: parts of 82 J, 82 N, 82 O, 83 C, 83 D, 83 E, and 83 F. Land Resource Research Institute, Research Branch, Agriculture Canada.

Notes : This series of 23 maps is a map supplement and accompanies W.D. Holland and G.M. Coen (1983) Ecological (Biophysical) Land Classification of Banff and Jasper National Parks, Alberta, Volume I: Summary, Alberta Institute of Pedology, Publication No. M-83-2, and W.D. Holland and G.M. Coen (1982) Ecological (Biophysical) Land Classification of Banff and Jasper National Parks, Alberta, Volume II: Soil and Vegetation Resources, Alberta Institute of Pedology, Publication No. SS-82-44.
Location : AEPAA, 574.5264 Ec73 (Entire report, including both volumes and maps as a set)
UA, WCW, Canada G-9
Areas : Map areas - 82 J, 82 N, 82 O, 83 SW
Borden areas - EQ, FQ
Topics : Ecological maps

c. Southeastern Alberta and Southern Saskatchewan

Stalker, A. MacS., and C.S. Churcher
1982 **Ice Age Deposits and Animals from the Southwestern Part of the Great Plains of Canada. Wall chart, Geological Survey of Canada Miscellaneous Report 31.**

Note : This is a revised, expanded and coloured version of the 1970 wall chart.
Location : UA, WCW, Alberta C-5:24
ADTMP, QE 185. G4 M531
Areas : Map areas - 72 E, 72 L, Saskatchewan - Wellsch Valley
Borden areas - DO, EO, region as above
Topics : Faunal remains, Quaternary stratigraphy, Wall chart

Stalker, A. MacS., and C.S. Churcher
1970 **Deposits near Medicine Hat, Alberta, Canada. Wall chart published by Surveys and Mapping Branch, Department of Energy Mines and Resources, Ottawa.**

Location : UA, WCW, Alberta geology
Areas : Map areas - 72 E, 72 L, Saskatchewan - Wellsch Valley
Borden areas - DO, EO, region as above
Topics : Faunal remains, Quaternary stratigraphy, Wall chart

d. Central and East-Central Alberta

Stalker, A. MacS.

1973 Map Showing Glacial Features, Drumheller area. Scale 1:250,000, NTS Sheet: 82 P. Figure 25, accompanies Geological Survey of Canada Memoir 370.

Location : UA, WCW, Alberta C-5:/65
AEU, SCI, QE 185. A2 No. 370
AEPAA, 557.1 C16 370
Areas : Map areas - 82 P
Borden areas - EP
Topics : Glacial map

e. Northern Alberta

Andriashek, L.D.

1985 Quaternary Stratigraphy, Sand River Area, Alberta. Scale 1:200,000, NTS Sheet 73 L. 2 sheets, Figures 9 and 10. Research Council of Alberta.

Note : Will be superseded by Research Council of Alberta Bulletin 57, in press (Andriashek, pers. comm. to ABB, 1989).
Location : UA, WCW, Alberta C-5:13/73L Fig. 9, Fig. 10
Areas : Map areas - 73 L
Borden areas - GO
Topics : Section diagrams

St-Onge, D.A.

1969 Geomorphology, Swan Hills. Scale 1:50,000, NTS Sheet: 83 J/11, Map 1206 A. Accompanies Geological Survey of Canada Paper 74-26.

Location : AEU, SCI, QE 185. C2 No. 74 (17-26)
UA, WCW, GSC, Series A, 1206A
AEPAA, 557.1 C16 P74-26
Areas : Map areas - 83 J
Borden areas - GP
Topics : Geomorphology maps

St-Onge, D.A.

1969 Quaternary Sections in the Swan Hills Region. Scales 1:50,000 (horizontal), 1:800 (vertical), NTS Sheet: 83 J/11, Map 1206 A. Figure 1, accompanies Geological Survey of Canada Paper 74-26.

Location : AEU, SCI, QE 185. C2 No. 74 (17-26)
UA, WCW, Alberta C-5:/65
AEPAA, 557.1 C16 P74-26
Areas : Map areas - 83 J
Borden areas - GP
Topics : Section diagrams

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Bobrowsky, P.T.
1989 Late Cenozoic Geology of the Northern Rocky Mountain Trench, British Columbia. Unpublished Ph.D. dissertation, Department of Geology, University of Alberta, Edmonton, Alberta.

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1952 A uniform site designation scheme for Canada. Archaeology in British Columbia 3:44-48

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1985 Union List of Scientific Serials in Canadian Libraries. Eleventh Edition. National Research Council of Canada, Ottawa.

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1988 The Paleoindian Component at Charlie Lake Cave (HbRf 39), British Columbia. American Antiquity 53:371-384.

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1984 Summary of Quaternary Stratigraphy and History. In Quaternary Stratigraphy of Canada - A Canadian Contribution to I.G.C.P. Project 24, edited by R.J. Fulton, pp. 69-83. Geological Survey of Canada Paper 84-10.

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1985 Index to Publications 1980-1984. Geological Survey of Canada, Ottawa. (321 pp.)

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1980 Index to Publications 1975-1979. Geological Survey of Canada, Ottawa. (257 pp.)

Griffin, P.J.
1975 Index to Publications 1959-1974. Geological Survey of Canada, Ottawa. (138 pp.)

Harington, C.R., and G. Rice

1984 Climatic Change in Canada 4. Annotated Bibliography of Quaternary Climatic Change in Canada. National Museums of Canada, National Museum of Natural Sciences, Project on Climatic Change in Canada During the Past 20,000 Years. Syllogeus No. 51. National Museums of Canada, National Museum of Natural Sciences, Ottawa. (368 pp.)

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1976 Dated Organic Material Below Mazama (?) Tephra: Elk Valley, British Columbia. Report of Activities, Part C, Geological Survey of Canada Paper 76-1C:169-170.

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INDEX

Page

Authors
- Aario, R. 270
- Alberta Research Council 335
- Alden, W.C. 123
- Alexander, D. 177, 335
- Alley, N.F. 33, 197, 260
- Andrews, H.R. 161
- Andrews, M. 335
- Andriashek, L. 319
- Andriashek, L.D. 26, 98, 238, 272, 273, 298, 299, 316, 319, 327, 334
- Antevs, E. 15
- Ashworth, A.C. 179
- Austin, G.H. 290
- Babcock, E.A. 98
- Bacon, C.R. 335
- Ball, G.C. 161
- Baranowski, S. 61, 290
- Barendregt, R.W. 34, 56, 83, 186, 260, 288
- Barton, R.H. 290
- Bayrock, L.A. 16, 17, 23, 27, 35, 38, 98-100, 104, 114, 166, 175, 293, 308, 309, 313, 319-324, 326, 327
- Beaty, C.B. 35
- Beaudoin, A.B. 56, 66, 140, 247, 265, 278, 304, 336, 337
- Berg, T. 295, 318
- Berg, T.E. 101
- Bergstrom, G. 140
- Beukens, R.P. 137
- Beus, S.S. 286, 287
- Bik, M.J.J. 83
- Bobrowsky, P.T. 274, 294, 335
- Bombin, E.R. 247, 278
- Bombin, M. 278
- Borden, C.E. 335
- Bowen, D.Q. 21, 124, 126
- Bowyer, A. 210
- Bowyer-Beaudoin, A. 266, 279, 304, 305
- Boydell, A.N. 56, 60, 210, 211, 265, 313

INDEX (continued)

Page

Bretz, J.H. 17
Briggs, N.D. 271
Broscoe, A.J. 290, 295
Brown, R.M. 161
Brulotte, R. 195
Brulotte, R.K. 255
Bryan, R.B. 84
Bryant, Jr., V.M. 130, 154
Bujak, C.A. 244
Burn, N. 161
Burns, J.A. 161, 162, 172, 176, 255
Caldas, E.F. 65
Campbell, I.A. 84
Canadian Institute for Scientific and Technical Information 335
Carrara, P.E. 123, 124, 275
Catto, N.R. 84, 101, 228, 270, 285
Cawker, K.B. 279, 304
Chambers, M.J. 36, 69, 88
Chorley, F.J. 304
Christiansen, E.A. 85-87, 102, 271, 287, 295
Christiansen, O.A. 134, 139, 303
Churcher, C.S. 34, 92, 93, 158, 168, 170, 172, 173, 176, 196, 271, 307, 332
Ciccone, B. 141
Clague, J.J. 35, 58
Clark, B.M. 58
Clayton, L. 17, 25, 26, 94
Clifford, H.F. 140
Collins, G.A. 102, 323
Colman, S.M. 62
Colton, R.B. 124
Craig, B.G. 77, 232, 323
Cwynar, L.C. 128
David, P.P. 87, 228, 271, 296
Davidson-Arnott, R. 115
Davis, L.B. 139
Davis, P.T. 258
Day, D.L. 198, 260

INDEX (continued)

Page

Delorme, L.D. 270, 304
Destraies, L. 285
Dethier, D.P. 62
Dormaar, J. 285
Dormaar, J.F. 18, 36, 57, 134, 139
Dove, J.E. 244
Dredge, L.A. 287
Dreimanis, A. 77, 115
Driver, J.C. 135, 162, 177, 245, 284, 335
Duff, D.E. 233
Duford, M. 268
Dumanski, J. 57
Dyke, A.S. 18, 329, 335
Elias, S.A. 157
Ellwood, B. 105
Ellwood, R.B. 105, 233, 324
Emerson, D. 152, 233
Eschman, D.F. 54, 260
Evans, M.E. 96, 298
Eyles, C.H. 58
Eyles, N. 58
Fahey, B.D. 115
Farvolden, R.N. 36, 102
Fedirchuk, G. 139
Fenton, M.M. 19-22, 26, 98, 115, 265, 286, 287, 319, 327, 335
Ferguson, A. 37
Ferguson, A.J. 199
Fergusson, A. 136
Fladmark, K.R. 122, 128, 177, 284, 335
Fleming, N.C. 28
Foit, Jr., F.F. 126
Folinsbee, R.E. 175
Forbis, R.G. 139, 167, 286, 288
Foster, J.H. 186
Fox, J.C. 212, 316
Fritz, P. 270, 281
Fuller, W.A. 175

INDEX (continued)

Page

Fullerton, D.S. 124
Fulton, R.J. 19-22, 29, 335, 337
Gambier, A.M. 213
Geist, V. 177
Geological Survey of Canada 335
George, H. 37
Glendinning, G.R. 213
Gold, C.M. 239
Goldthwait, R.P. 86, 108
Gorman, W.A. 37
Gowan, R. 316
Graham, M.A. 163
Graham, R.W. 163
Grant, D.R. 330
Gravenor, C.P. 23, 38, 103-106, 323, 324
Green, R. 270, 281
Griffin, P.J. 335
Habgood, T. 153, 305
Hansen, H.P. 137, 141, 149, 152
Haringtcn, C.R. 128, 134-136, 158, 159, 168, 173, 176, 179, 336
Harris, S.A. 33, 38, 59-61, 141, 142, 265, 266
Harrison, J.E. 39, 53, 180, 183, 309, 336
Harvey, D. 288
Harvey, D.W. 167
Hawes, R.J. 200, 261
Hemphill, C.R. 287
Henderson, E.P. 80, 239, 316
Henoch, W.E.S. 61, 290, 291
Heusser, C.J. 142
Hickman, M. 153, 280, 282, 305
Hillerud, J.M. 257
Hills, L.V. 128, 134-136, 169, 285, 303
Holland, D.K. 248, 266, 279
Holland, K. 304, 305
Holloway, R.G. 130, 154, 253, 282
Holter, M. 290
Hooke, R. Le B. 26

INDEX (continued)

Page

Horberg, L. 39, 40, 125, 180
Horton, D.G. 277
Howell, J. 266
Howell, J.D. 60, 61, 214, 266
Hrapko, J. 292
Hughes, G.M. 100, 234, 235, 323
Imahori, Y. 161
Ives, J.W. 336
Jackson, Jr., L.E. . . 24, 40, 41, 56, 61, 62, 78, 79, 138, 143, 180, 201, 262, 286, 303, 309, 336
Jenness, D. 24
Jennings, A.H. 215
Jennings, E.W. 287
Johnston, A.G. 336
Johnston, W.A. 24, 88
Jones, J.F. 35, 81, 227, 309, 316
Jungerius, P.D. 88
Kalas, L. 270, 281, 298
Karlén, W. 44
Karlstrom, E.T. 41-43, 201, 261, 262, 275, 286, 287
Kathol, C.P. 325, 327
Kearney, M.S. 66, 143-146, 249, 291, 304, 305
Kieser, W.E. 137
King, R.H. 56, 62, 63, 66, 67, 265, 266, 278, 304
Kingston, M.S. 202
Kjearsgaard, A.A. 185
Klarer, D.M. 153
Klassen, R.W. 25, 89, 186, 287
Kodama, H. 116
Kostaschuk, R.A. 63, 215, 266
Kotylak, J.T. 305
Kucera, R.E. 291
Kulig, J.J. 262
Kupsch, W.O. 106
Kvill, D.R. 216, 267
La Rocque, A. 148
Langston, W. 163

INDEX (continued)

Page

Le Breton, E.G. 36, 102
Leggat, K.R. 305, 337
Legget, R.F. 23, 115
Lemke, R.W. 125
Lennox, D.H. 36, 102
Leonard, E.M. 64, 217, 267
Leslie, L.E. 242
Levson, V. 64, 268, 294
Levson, V.M. 218, 268
Lichti-Federovich, S. 146, 193, 194, 336
Limbird, A. 65
Lindsay, J.D. 57, 111
Lindsey, C.C. 283
Liverman, D.G.E. 270, 294
Love, M.A. 203
Luckman, B. 285, 292
Luckman, B.H. 25, 61, 66, 67, 70, 143-146, 279, 291, 305
Lutwick, L.E. 36, 57
MacDonald, G.M. 62, 128, 129, 137, 147, 149, 243, 250, 266, 276
Magne, M.P.R. 336
Mahaney, W.C. 20, 34, 54, 90, 121, 145, 158, 170
Mandryk, G. 268
Mandryk, G.B. 204
Masters, P.M. 28
Mathewes, R.W. 150, 151, 156
Mathews, W.H. 43, 81, 119, 150, 151, 190, 270, 274, 301, 336
Matt, C.D. 219
Matthews, Jr., J.V. 270, 281
May, R.W. 107, 292
McCabe, A.M. 58
McKeague, J.A. 116
McKinnon, N.A. 59, 132, 135
McLaren, P. 183
McPherson, H.J. 60, 67, 76, 220, 291
McPherson, R.A. 318, 327
Mehringer, Jr., P.J. 126
Meneley, W.A. 36, 102, 106

INDEX (continued)

Page

Meyboom, P. 36, 102
Milton, J.C.D. 161
Minning, G.V. 191
Moffatt, E.A. 164
Moore, T.A. 29
Moran, S.R. 17, 25, 26, 68, 94, 265, 292, 313, 314
Morgan, A.V. 69, 221
Morlan, R.E. 336
Mott, R.J. 138, 192, 194
Mountjoy, E.W. 69, 72
Mudge, M.R. 125
Murray, D.F. 276
National Library of Canada 336
Nelson, J.G. 36, 69, 70, 88
Nichols, H. 114
Nickling, W. 115
Nielsen, E. 287
Odynsky, W. 26, 82
Osborn, G. 37, 44, 70, 258, 262, 268, 285, 292
Osborn, G.D. 44, 45, 66, 67, 70
Oschinsky, L. 163
Ouellet, M. 154
Packer, J.G. 129, 147, 276
Parris, J.H. 222
Pawlowicz, J.G. 286
Pawluk, S. 17, 27, 30, 46, 57, 111, 113, 114
Pawson, M. 24, 336
Pelletier, R. 285
Pelzer, E.E. 301
Pennock, D.J. 205
Perrin, D.W. 336
Pheasant, D.R. 223
Pip, E. 142
Porter, S.C. 337
Powers, H.A. 125
Prest, V.K. 18, 329, 330, 335
Proudfoot, D.N. 229, 263, 265, 271, 292

INDEX (continued)

Page

Putnam, P.E. 266
Rains, B. 108
Rains, R.B. 108
Rampton, V.N. 120, 330
Ramsden, J. 108, 236
Reasoner, M.A. 71, 251, 280
Reeves, B. 27, 45
Reeves, B.O.K. 28, 135, 139, 150, 258, 285, 336
Reimchen, T.H. 308, 313, 327
Reimchen, T.H.F. 190, 254
Rhine, J.L. 240, 273
Rice, G. 336
Richard, S.H. 327
Richardson, R.J.H. 316
Richmond, G.M. 21, 124, 126, 127
Ritchie, J.C. 129-131, 276, 277
Robie, R.A. 40
Roed, M. 292
Roed, M.A. 72, 73, 314
Ronaghan, B.M. 302, 337
Root, J.D. 319
Ross, D.M. 175
Russell, L.S. 307
Rutherford, L. 45
Rutter, N.W. 21, 22, 29, 30, 54, 64, 71-75, 120, 121, 177, 183, 190, 191, 223, 258, 268, 270, 285, 287, 292, 294, 314, 335, 337
Sanborn, P. 46
Sangster, E.V. 128
Sauer, E.K. 87
Schreiner, B.T. 287
Schuppli, P.A. 116
Schweger, C. 280, 292, 305
Schweger, C.E. 153, 282
Semken, Jr., H.A. 163
Shackleton, D.M. 168, 169, 177
Sham, P.C. 316
Sharp, D. 292

INDEX (continued)

Page

Shaw, J. 76, 109, 116, 292
Sheppard, J.C. 126
Shetsen, I. 46, 262, 309, 310, 331
Short, S.K. 124
Shutler, Jr., R. 128, 336
Sibrava, V. 21, 124, 126
Slaymaker, H.O. 60, 76, 291
Smith, D.G. 63, 273
Smith, D.G.W. 114
Smith, R.A. 27
Spurling, B.E. 122
St-Onge, D.A. 93, 111, 117, 185, 189, 317, 327, 334
Stalker, A. MacS. 31, 34, 47-53, 76, 77, 90-93, 110, 164, 165, 173, 181, 182, 186-188, 192, 259, 260, 263, 271, 287, 288, 293, 296, 310, 311, 315, 325, 332, 333
Steer, D. 306
Stene, L.P. 54, 205, 224
Sternberg, C.M. 159, 160
Storer, J.E. 176, 195
Strong, W.L. 337
Stryd, A.H. 27
Stuart, G.S.L. 59, 132, 135
Sundick, R.I. 165
Swan, A.G. 102, 323
Szabo, B.J. 93
Taylor, R.S. 118
Teller, J.T. 94
Terasmae, J. 132
Tharin, J.C. 77, 225
Thompson, S. 107
Trylich, C. 166
Twardy, A.G. 111
Valastro, S. 154
Valentine, K.W.G. 122
Vance, R.E. 132, 133, 155, 277, 302, 337
VanDine, D.F. 37
Vernon, P.D. 206
Vickers, J.R. 286, 287

INDEX (continued)

Page

Vitt, D. 292
Vitt, D.H. 137, 147, 277
Vreeken, W.J. 89, 94
Vucetich, C.G. 57
Wagner, W.P. 54, 207
Wainwright, I.N.M. 164
Walker, M.J.C. 77, 225, 268
Wasylyk, D.G. 73
Waters, P.L. 54, 208
Waters, R.R. 38, 208
Welch, J. 108
West, F.H. 337
Westgate, J.A. 31, 77, 95, 96, 108, 113, 114, 230, 264, 270, 271, 281, 297, 298, 318
White, J. 306
White, J.M. 150, 151, 156, 252, 306
Wickenden, R.T.D. 88
Wilcox, R.E. 124, 125, 275
Williams, G.D. 293
Wilson, M. 148, 166, 169, 288
Wilson, M.C. 56, 61, 62, 78, 79, 163, 167, 170, 172, 269, 285
Wright, Jr., H.E. 74, 337
Wyder, J.E. 75, 92
Yaalon, D.H. 65
Yair, A. 84
Yarranton, G.A. 131
Zell, R.L. 295-297

Borden areas
- Alberta - Northern 330
- All Alberta 16, 22-29, 31, 128-130, 132, 133, 158-160, 254, 258, 276, 277, 285
- All Alberta except Mountains and Foothills 17, 20, 24
- All Canada 329, 330
- DO 17, 18, 24, 29-32, 34-38, 40, 44, 46-48, 51, 83-85, 88, 89, 91, 95-97, 113, 125, 139, 173, 181, 186, 196, 228, 230, 231, 262-264, 269, 271, 276, 277, 283, 286-288, 295-297, 307, 309, 311, 318, 332
- DP 17, 18, 21, 24, 29-31, 33-40, 42-55, 59, 60, 71, 76, 77, 88, 91, 125, 129, 134-136, 139, 142, 158, 161-167, 170, 180-182, 188, 195, 198, 202, 206-208,

244, 246, 255, 256, 258, 260-264, 269, 276, 277, 283, 285-289, 296, 302, 303, 308-312

EO . 17, 18, 24, 31, 34-38, 44, 46-48, 51, 56, 84, 88, 91-94, 103, 113, 139, 158, 163, 165, 170, 173, 174, 179, 181, 186-188, 192, 196, 228, 230, 262, 263, 269, 271, 286, 287, 295, 296, 307, 309, 311, 318, 332

EP 17, 18, 21, 24, 25, 29-31, 33-38, 41, 44-49, 51, 53-56, 58-62, 64, 65, 67, 69, 70, 73-79, 87, 88, 91, 106, 110, 129, 134, 135, 137, 138, 139, 141-143, 147, 148, 158, 161-163, 166, 168-171, 176, 180, 181, 183, 184, 195, 198, 199-201, 203-206, 208, 209, 211, 214, 216, 220-226, 232, 245, 250, 256, 258, 260-269, 276, 277, 283, 285-288, 290-293, 302-304, 306-311, 313-315, 323, 325, 331, 333

EQ 18, 21, 25, 29, 30, 45, 56, 60-64, 67, 68, 71, 75, 76, 78, 129, 143, 212, 215, 218, 258, 264-268, 276, 277, 279, 280, 283, 291, 292, 302, 304, 305, 308, 331

FO 17, 18, 36-38, 46, 51, 98-100, 103-107, 112, 113, 116, 139, 236, 319-324

FP . . . 17, 18, 24, 29-32, 36-38, 46, 48, 51, 53, 55-57, 59, 60, 77, 98, 99, 101-103, 107-109, 111-114, 118, 129, 134, 139, 141, 142, 152, 153, 154, 170, 175, 176, 179, 181, 208, 212, 217, 233-235, 237, 253, 257, 265, 267, 272, 276, 277, 282, 283, 285, 291-293, 298, 305, 308, 313, 319, 323, 325

FQ . . . 17, 18, 21, 24, 25, 29, 30, 45, 46, 53, 56-63, 65-69, 71-73, 76-78, 107, 111, 118, 129, 140, 141, 143-145, 147, 148, 154, 210, 213, 215, 217, 219, 225, 233, 247-250, 258, 265-268, 276-280, 282, 283, 285, 290-294, 302, 304, 305, 308, 314, 331

GO 36, 107, 131, 132, 236, 238, 239, 273, 280, 282, 299, 305, 327, 334

GP . 29-31, 36, 106, 107, 111, 113, 117, 131, 132, 146, 149, 152, 170, 185, 189, 193, 194, 276, 277, 283, 305, 327, 334

GQ . . . 21, 29, 30, 81, 82, 103, 107, 111, 116, 129, 149-151, 170, 172, 185, 194, 227, 240, 270, 276, 277, 281, 283, 294, 302, 308, 316, 317

. . . . 190, 191, 301

GR 103, 107, 115, 118, 241, 326-328

HO 107, 118, 155, 241, 273, 282

HP . . . .

HQ . . . 29, 30, 32, 44, 81, 82, 107, 118, 129, 150, 170, 172, 194, 243, 273, 276, 277, 283, 316

. . . . 119, 122, 151, 156, 177, 190, 243, 284, 301

HR 107, 118, 241, 273, 326

IO 107, 118, 241, 243, 273, 326

IP 82, 107, 118, 316

IQ . . . .

INDEX (continued)

Page

Map areas
- 72 C . . . 44
- 72 E . . 17, 18, 24, 29-32, 34-36, 40, 46-48, 51, 83-85, 88, 91, 95, 96, 125, 139, 173, 181, 186, 196, 228, 230, 231, 262-264, 269, 271, 276, 277, 283, 286-288, 295-297, 307, 309, 311, 318, 332
- 72 F . . . 89, 296
- 72 G . . . 38, 51
- 72 K . . . 87, 229
- 72 L . 17, 18, 24, 29-31, 34-36, 38, 44, 46-48, 51, 84, 88, 91-94, 113, 139, 158, 163, 165, 170, 173, 179, 181, 186-188, 192, 196, 228, 230, 262, 263, 269, 271, 276, 277, 283, 286, 287, 295, 296, 307, 309, 311, 332
- 72 M . . . 17, 18, 36, 38, 46, 47, 51, 88, 103, 113, 262, 286, 309, 311
- 73 D . . . 17, 18, 36, 38, 46, 51, 93, 98-100, 103-107, 113, 319-322, 324
- 73 E . . . 17, 36, 38, 46, 51, 93, 99, 100, 103, 106, 107, 112, 113, 116, 233, 236
- 73 G . . . 18
- 73 L . . . 36, 56, 107, 116, 131, 132, 236, 238, 239, 273, 280, 282, 299, 305, 327, 334
- 73 M . . . 56, 107
- 74 D . . . 107, 115, 327, 328
- 74 E . . . 103, 107, 115, 326, 328
- 74 L . . . 107, 326
- 74 M . . . 107, 326
- 74 NW . . . 118, 241, 273
- 74 P . . . 243
- 74 SW . . . 118, 241, 273
- 82 G . 17, 18, 21, 24, 29-31, 33-39, 42, 44-51, 53-55, 71, 76, 91, 129, 134-136, 139, 142, 158, 161-163, 195, 197, 198, 202, 206, 208, 244, 246, 255, 256, 258, 260-263, 269, 276, 277, 283, 285, 287, 288, 302, 303, 308, 309, 311
- 82 H . . 17, 18, 21, 24, 29-31, 33-36, 38-40, 42-55, 59, 60, 76, 77, 88, 91, 125, 129, 134, 135, 139, 142, 161, 163-167, 170, 180-182, 188, 197, 198, 202, 206-208, 244, 258, 260-263, 269, 276, 277, 283, 285-289, 296, 302, 303, 308, 309-312
- 82 I . 33-35, 38, 41, 44, 51, 53, 54, 62, 77, 79, 88, 91, 106, 134, 163, 170, 181, 197, 198, 204, 205, 208, 209, 260, 262, 286-288, 293, 308, 309-311, 313
- 82 J . . . 18, 24, 33, 34, 36-38, 41, 44-46, 49, 53, 54, 62, 65, 67, 71, 77, 79, 91, 128, 134, 135, 137, 138, 142, 147, 158, 161, 162, 171, 180, 181, 183, 197-201, 203-206, 208, 209, 214, 250, 256, 258, 260-262, 268, 286-288, 302, 303, 308-310, 313, 314, 331
- 82 K . . . 71

Page

82 N . . 18, 25, 29, 30, 45, 56, 60-64, 67, 68, 71, 75, 76, 78, 129, 143, 212, 215, 218, 258, 265-268, 276, 277, 279, 280, 283, 285, 291, 292, 302, 304, 308, 314, 331
82 NE . . . 17, 18, 21, 25, 29-31, 36, 38, 46, 47, 55, 59-61, 69, 76, 79, 129, 139, 166, 221, 225, 263, 265, 266, 269, 276, 277, 283, 285, 287, 309, 311, 331
82 NW 48, 263
82 O 18, 24, 38, 45, 49, 51, 53, 58, 60-62, 64, 65, 67, 70, 71, 73-79, 134, 135, 141-143, 147, 148, 163, 168-170, 183, 200, 204, 208, 211, 214, 216, 220-224, 226, 245, 250, 258, 261, 262, 265-268, 286, 291, 292, 302-304, 306, 307, 308, 310, 314, 331
82 P . 51, 53, 56, 60, 88, 110, 134, 163, 169, 170, 176, 179, 195, 208, 214, 232, 262, 286, 290-292, 307, 313, 315, 323, 325, 333
82 SE 18
83 118
83 A . . . 48, 51, 55, 56, 60, 93, 99, 102, 103, 109, 111, 112, 134, 139, 152, 208, 282, 285, 291, 292, 325
83 B . 21, 29, 30, 48, 53, 55, 57, 60, 77, 129, 142, 208, 212, 217, 265, 267, 276, 277, 283, 291, 292, 308, 313
83 C . . 18, 25, 45, 46, 53, 56, 57, 59-61, 63, 66-68, 78, 107, 128, 140, 143-145, 147, 148, 210, 215, 217, 247, 249, 265-268, 278-280, 282, 290-292, 304, 305, 308
83 D 25, 45, 66, 67, 143-145, 147, 292, 304, 305, 308
83 E 45, 67, 143, 308
83 F . . 18, 24, 45, 46, 53, 58-60, 67, 72, 73, 107, 111, 140, 141, 213, 225, 248, 265, 278, 282, 292, 293, 304, 308, 314
83 G . . 18, 24, 29, 30, 93, 98, 102, 109, 112, 114, 141, 153, 154, 253, 257, 265, 276, 277, 282, 283, 285, 292, 293, 305, 319, 323
83 H . . . 18, 24, 32, 55, 93, 99, 101, 102, 107-109, 112-114, 152, 154, 170, 175, 176, 181, 208, 233-235, 237, 272, 282, 285, 292, 293, 298, 305, 319, 323, 325
83 I 31, 36, 106, 113, 131, 132, 146, 152, 170, 185, 189, 193, 305
83 J 29-31, 36, 93, 117, 189, 276, 277, 283, 327, 334
83 K 93, 111, 172, 185, 270, 317
83 L 270, 281, 302, 305, 308, 316
83 M 81, 82, 103, 128, 149-151, 170, 172, 227, 270, 281, 294, 316
83 N 81, 82, 111, 116, 149, 170, 172, 194, 240, 264, 270, 281, 316
83 NE 107, 111
83 NW 21, 29, 30, 82, 107, 129, 270, 276, 277, 283
83 O 149, 327
83 P 149, 194

INDEX (continued)

Page

83 SE 17, 18, 31, 36, 38, 46, 51, 59, 60, 107, 111, 112, 292
83 SW . 17, 21, 29, 30, 62, 65, 69, 71, 76, 77, 129, 219, 250, 258, 268, 276, 277, 283, 285, 291, 292, 294, 302, 331
84 .... 107, 118
84 C 29, 30, 32, 81, 170, 172, 276, 277, 283, 316
84 D 21, 29, 30, 81, 128, 150, 172, 194, 243, 276, 277, 283, 316
84 H 155, 282
84 I 326
84 K 316
84 NE 241, 273
84 NW 82
84 P 326
84 SE 241, 273
84 SW 44, 82, 270
85 E 191
93 N 191
93 O 191
93 P 190, 301
94 A 119, 122, 151, 156, 177, 190, 301
94 B 191
94 C 191
94 E 191
94 H 243
95 A 191
95 B 191
95 H 191
95 J 191
Alaska 128, 159, 276, 277
Alaska - Eastern 21, 130, 277
Alberta - Northern 330
All Alberta 16, 22-29, 31, 128-130, 132, 133, 158-160, 254, 258, 276, 277, 285
All Alberta except Mountains and Foothills 17, 20, 24
All Canada 16, 25, 128, 130, 132, 329, 330
All Canada except British Columbia 19
Beringia 25, 128
British Columbia 21, 71, 130, 159
British Columbia - Central 179

INDEX (continued)

Page

British Columbia - Eastern 258
British Columbia - Elk Valley 28, 36, 37, 137, 180, 199
British Columbia - Mount Robson Provincial Park 143
British Columbia - Northeastern . 27-30, 82, 118-122, 129, 150, 151, 156, 158, 177, 178, 190, 191, 242, 243, 258, 270, 274, 276, 277, 283, 284, 294, 301
British Columbia - Northern 128
British Columbia - Southeastern 128
British Columbia - Southern 160, 264, 291
British Columbia - Yoho National Park 72, 143, 212, 251, 268, 280
British Columbia Rockies 67
Canada - Western 15, 128
Greenland 128
Illinois 18
Iowa 18, 94
Manitoba 18, 20, 26, 31, 130-133, 159, 276, 287
Manitoba - Southeastern 115
Manitoba - Southern 18, 25, 179, 287
Minnesota 18, 131
Montana 96, 163
Montana - Glacier National Park . 39, 42, 44, 45, 123-126, 137, 202, 261, 262, 275, 286, 287
Montana - Northern 18, 38, 40, 44, 85, 124-126, 157
Montana - Northwestern 275
Montana - Western 123, 126
Nebraska 18, 131
New Brunswick 159
North America 16
North America - Northern 128
North Dakota 18, 179
North Dakota - Northern 85
Northwest Territories 130, 133, 158, 159, 191, 243, 273, 276, 277, 283
Northwest Territories - Southwestern 128, 129
Northwest Territories - Western 28
Nova Scotia 159
Ontario 159
Ontario - Northwestern 18
Ontario - Southern 179

INDEX (continued)

Page

Ontario - Southwestern . . . 115, 158-160
Quebec . . . 159
Quebec - Southeastern . . . 158
Saskatchewan . . . 20, 26, 28, 29, 31, 130-133, 159, 276, 287
Saskatchewan - Central . . . 85, 106, 107, 296
Saskatchewan - Cypress Hills . . . 187, 228
Saskatchewan - Northern . . . 117, 118, 273
Saskatchewan - Southern . 18, 25, 27, 38, 44, 85-89, 93-95, 106, 125, 159, 160, 163, 165, 179, 188, 229, 271, 287, 295, 296
Saskatchewan - Wellsch Valley . . . 34, 90-92, 158, 186-188, 196, 307, 332
Saskatchewan - West-Central . . . 102
Saskatchewan - Western . . . 16
South Dakota . . . 18, 131
United States - Northern . . . 179
United States - Northern Rockies . . . 126, 127, 258
United States - Southern Rockies . . . 258
United States - Western . . . 15
Vancouver Island . . . 176
Washington . . . 96
Western Canada . . . 22, 23
Wisconsin . . . 18
Wyoming - Northern . . . 123
Wyoming - Yellowstone National Park . . . 96
Yukon . . . 21, 27-29, 31, 128, 130, 158, 159, 276, 277, 283
Yukon - Northern . . . 133

Topics
  Alluvial sequences . . . 108
  Amino acid dating . . . 72, 251, 270, 274
  Analysis of air photographs . . . 103
  Analysis of radiocarbon dates . . 18, 24, 25, 28, 36, 37, 41, 50, 52, 59, 60, 66, 71, 94, 106, 111, 121, 122, 126, 138, 141, 143, 151, 154, 161, 180, 185, 229, 252, 262, 264, 270, 271, 274, 275, 291, 295
  Archaeological sites . . . 15
  Archaeological sites - Calgary area . . . 79
  Archaeological sites - DiPj-3 . . . 36
  Archaeological sites - DjPk-1 . . . 36

INDEX (continued)

Page

Archaeological sites - DjPo-137, DjPo-138 and DjPo-139 285
Archaeological sites - DjPo-47 .... 135, 162
Archaeological sites - DkPj-1 .... 188, 285, 286
Archaeological sites - DkPp-11 .... 195, 255
Archaeological sites - DlOv-2 286
Archaeological sites - DlPa-4 .... 49, 161, 163-165, 167, 286, 289
Archaeological sites - DlPk-3 36
Archaeological sites - DlPo-20 139
Archaeological sites - DlPo-4 255
Archaeological sites - EaPe-1 286
Archaeological sites - EgPm-127 79
Archaeological sites - EgPm-3 .... 79, 148, 170
Archaeological sites - EhPv-8 306
Archaeological sites - FiPn-18 257
Archaeological sites - HaPk-1 122
Archaeological sites - HbRf-39 .... 177, 284
Archaeological sites - Southern Alberta 287
Archaeology 135, 246, 269
Archaeology - human population movement 27-29, 128
Archaeology - site distribution 291
Artifacts 79, 92, 122, 135, 139, 162, 163, 165, 166, 170, 177, 255
Bedrock blocks 181, 208, 288
Bedrock channels 36, 37, 102
Bedrock geology 56, 81, 298
Biogeography - brassy minnows 281
Biogeography - fish 283
Biogeography - *Salmasellus* 140
Biogeography - *Thomomys* 161
Bog cores 247, 251
Buried channels 81
Buried valleys 31, 72, 175, 181, 238, 239, 298, 299, 301
Carbon isotope studies 144
Cave deposits 162, 177, 195, 255, 256, 284
Charcoal - fire history 150, 210, 247, 249, 250
Climate history 134
Climatic modelling 133
Dendrochronology 45, 67, 124, 275, 305

INDEX (continued)

Page

Dendroecology ... 279
Diamicton - fabric ... 242
Diamicton - lithology ... 230, 242
Diamicton - mineralogy ... 167, 289
Diamicton - physical characteristics ... 289
Diamicton - physical properties ... 242, 262
Diatoms ... 153, 248, 278, 280, 282, 305, 306
Disjunct plant distributions ... 148
Drainage systems ... 31, 104
Drilling ... 75, 86, 93, 106, 107, 115, 183, 185, 187, 238, 239, 271, 272, 287, 298, 299, 301
Ecological maps ... 331
Erratics ... 24, 46
Erratics - Okotoks ... 293
Erratics train ... 53, 62, 69, 72, 73, 77, 180, 181, 201, 207, 208, 211, 222, 230, 232, 260, 262, 265, 285-287, 293
Fabric studies ... 233
Facies studies ... 65, 204, 219, 262, 268
Faunal remains ... 34, 76, 78, 91, 92, 158, 159, 163, 165, 176, 177, 186-189, 192, 195, 196, 246, 255, 256, 298, 303, 307, 332
Faunal remains - *Antilocapra* ... 254, 289, 295
Faunal remains - *Bison* ... 50, 79, 117, 135, 139, 148, 166, 168-172, 177, 185, 254, 257, 265, 269, 289
Faunal remains - *Camelops* ... 79, 170-172, 254
Faunal remains - *Cervus* ... 168, 169, 172
Faunal remains - *Citellus* ... 254
Faunal remains - *Cynomys* ... 195
Faunal remains - *Equus* ... 79, 96, 117, 168, 170-175, 190, 254, 298
Faunal remains - fish ... 283
Faunal remains - *Hemiauchenia* ... 172
Faunal remains - *Hirundo* ... 177
Faunal remains - *Lemmus* ... 162
Faunal remains - *Lepus* ... 177, 289
Faunal remains - *Mammuthus* ... 79, 96, 117, 159, 160, 169, 170, 172-175, 179, 190, 254, 297, 298
Faunal remains - *Mastodon* ... 159, 160
Faunal remains - *Microtus* ... 162

INDEX (continued)

Page

Faunal remains - *Ovibos* 172
Faunal remains - *Ovis* 162, 168, 170, 178
Faunal remains - *Panthera* 173, 174
Faunal remains - *Rangifer* 168, 170
Faunal remains - *Spermophilus* 172, 177
Faunal remains - *Symbos* 176
Faunal remains - *Thomomys* 161
Faunal remains - *Titanotylopus* 254, 298
Field trip guide 102, 285-288, 290-296, 298, 301, 303
Fire history 57, 244
Geoarchaeology 49, 79, 122, 164, 167, 289
Geochemistry 90
Geomorphological maps 330
Geomorphology 89, 291, 295
Geomorphology - alluvial fans 73, 216, 267
Geomorphology - alluvial sequences 45, 62, 70, 76
Geomorphology - badlands 56, 84
Geomorphology - Canadian Rockies 291
Geomorphology - coulee alignment 35
Geomorphology - dunes 26, 229, 241, 291
Geomorphology - flutings 107
Geomorphology - general 117
Geomorphology - karst 290
Geomorphology - meltwater channels 70
Geomorphology - rock glaciers 67
Geomorphology - sand dunes 287
Geomorphology - terraces . . . 62, 76, 78, 79, 108, 113, 120, 170, 205, 206, 225, 240,
242, 266, 269, 285
Geomorphology maps 334
Geotechnical studies 107
Glacial chronology . . 16, 17, 22, 24, 25, 31, 33, 34, 37-42, 44-50, 53, 54, 57, 59-62,
64, 65, 67-69, 72-76, 78, 79, 81, 82, 86-89, 93. 95, 96, 102, 106, 110-113,
118-122, 124-127, 141, 143, 145, 190, 198-202, 204, 206-209, 211-215, 217,
218, 219-233, 235, 238-242, 249, 251, 258-271, 274, 275, 281, 285-287,
291-299, 301, 304, 305

INDEX (continued)

Page

Glacial geomorphology 37-39, 46, 48-50, 53, 60, 61, 64, 67-70, 74-76, 81, 99, 100, 103, 105, 110, 119, 123, 185, 212, 215, 217, 221-223, 231, 233, 242, 267, 285, 287, 290-292, 295, 301
Glacial geomorphology - "ice-pressed" features 51, 260
Glacial geomorphology - drumlins 77, 116, 117, 213, 22[illegible], 236, 269
Glacial geomorphology - flutings 107, 116, 213, 236
Glacial geomorphology - glacial thrust terrain 26
Glacial geomorphology - ice disintegration features 106
Glacial geomorphology - moraines 17, 46, 105, 112, 113, 234, 260, 262
Glacial geomorphology - mounds 82, 234
Glacial geomorphology - prairie mounds 104
Glacial geomorphology - streamlined terrain 26
Glacial history 15, 77, 236, 291
Glacial lake sequences 15, 18, 34, 37-40, 57, 59, 60, 62, 64, 69, 72, 78, 81, 82, 84, 86, 88, 93, 96, 101, 110, 111, 118-122, 126, 141-143, 151, 180, 182, 185, 190, 191, 198, 201, 204, 208, 209, 211, 212, 214, 216, 222, 226-228, 230, 232, 235, 238, 239, 241, 252, 260, 262, 263, 265, 266, 268-270, 273, 274, 281, 285-287, 290, 291, 295, 298, 299, 301
Glacial map 333
Glaciation maps 329, 330
Glaciology 291
Glaciotectonic structures 98
Groundwater resources 81, 229
Holocene timberline fluctuations 45, 66, 136, 140, 144, 145, 147, 247, 250, 251, 278, 280, 285, 304, 305
Ice movement indicators 24, 32, 38, 47, 77, 107, 109, 113, 116, 117, 119, 213, 217, 236-239, 285, 300
Ice sheet profiles 44, 46
Ice-free corridor 15, 16, 27-30, 41, 48, 59, 128-130, 138, 151, 252, 258, 259, 262, 263, 267, 270, 276, 277, 280, 281, 283
Insect studies 124, 137, 157, 252, 270, 275, 281
Lake cores 194, 218, 244-246, 248, 251-253, 278, 280, 282
Laurentide ice sheet dynamics 19
Lichenometry 44, 45, 67
Loess 81, 216, 229, 245
Loess - heavy minerals 297
Loess - palaeowind direction 85

INDEX (continued)

Page

Loess - sedimentary characteristics 58, 84, 85, 89, 95, 297
Megablocks 288
Modern pollen studies 129, 243, 250
Molluscs 50, 60, 92, 137, 142, 144, 147, 148, 151, 152, 154, 166, 189, 198, 229, 234, 245, 250-252, 265, 270, 281, 298
Neoglaciation 38, 39, 44, 45, 72, 124, 199, 212, 218, 224, 244, 250, 275, 290
Opal phytoliths 36, 55, 208
Ostracods 137, 142, 151, 245, 252, 270, 281, 304, 306
Oxygen isotope studies 45, 144, 147, 234, 250, 270, 279, 281, 298
Palaeolimnology 153, 248, 280
Palaeomagnetism 20, 34, 42, 43, 83, 97, 186, 274, 287, 289, 298
Palaeontology 307
Palaeosols 36, 39, 41-43, 46, 50, 55, 58, 79, 88, 89, 95, 122, 125-127, 134, 139, 173, 183, 184, 187, 202, 205, 208, 212, 213, 229, 261, 262, 269, 271, 275, 285-287, 295, 296, 304
Palaeowind direction 26, 35
Paraglacial landforms 62, 170, 269, 273
Paraglacial landforms - alluvial fans 73
Paraglacial processes 58, 59, 76, 78
Periglacial features 236, 298
Periglacial geomorphology 39, 114
Periglacial geomorphology - ice wedge casts 275
Periglacial geomorphology - mounds 81, 240
Periglacial geomorphology - prairie mounds 84
Periglacial geomorphology - sand wedges 101
Periglacial processes 84
Phytogeography 129
Pigments 153, 282
Plant macrofossils 303
Plant macrofossils - Bryophytes 137, 138, 252
Plant macrofossils - *Chara* oogonia 142
Plant macrofossils - leaves 137
Plant macrofossils - needles 72, 144, 145, 147, 194, 251, 275, 280
Plant macrofossils - *Picea* remains 138
Plant macrofossils - seeds 144, 151, 189, 194, 252, 281
Plant macrofossils - wood 66, 106, 118, 124, 137, 138, 144, 145, 147, 166, 175, 189, 192, 199, 244, 270, 275

INDEX (continued)

Page

192, 199, 244, 270, 275
Plant migration 129, 243
Plant refugia 129, 148, 277
Pollen analysis 37, 45, 124, 126, 129, 132, 134-138, 140-147, 149, 151-156, 166, 180 192-194, 198, 199, 217, 243-253, 256, 270, 276, 278-280, 282, 285, 298, 303-306
Pollen analysis - multivariate statistical methods 129, 132, 133, 150, 277
Pollen ratios 278
Publications list 128
Quaternary stratigraphy 33-35, 39-42, 47, 49, 50, 52-54, 57, 60, 62, 65, 69, 72, 74-76, 78, 79, 81, 82, 85-87, 89, 92-96, 98-100, 102-108, 110-113, 118, 119, 121-124, 126, 164, 180-185, 187-191, 198, 201, 207, 219, 224, 225, 228, 229, 232-235, 237-240, 258, 260, 262-265, 270-274, 285-289, 291-298, 300, 301, 303-305, 307, 332
Quaternary stratigraphy - Saskatchewan gravels and sands . . 16, 31, 40, 96, 98, 109, 113, 114, 175, 189, 254, 298
Reconstruction of ice surface 296
Refugia 140
Review of archaeological evidence 79, 128, 139
Review of archaeology 286
Review of faunal studies 60, 158, 159, 163, 175
Review of glacial chronology 19, 71
Review of glacial geomorphology 62
Review of glacial history 16, 18, 20, 21, 23, 25, 27-30, 38, 67, 76, 128
Review of ice dynamics 285
Review of migrations 25
Review of mountain geomorphology 25
Review of palaeoenvironmental studies 28, 128, 139, 276, 277
Review of palaeomagnetic studies 83
Review of palaeosol studies 18, 31
Review of pollen studies 130, 131, 302
Review of Quaternary stratigraphy 20-23, 51, 91, 125, 126
Review of vegetation history 60, 130-132, 302
Sand and gravel resource maps 331
Section diagrams 334
Sedimentology 64, 206, 216, 218, 221, 225, 230, 241, 267, 273, 292
Sedimentology - debris flows 58, 59, 76
Sedimentology - processes 58, 59, 76

INDEX (continued)

Page

Sediments - clay mineralogy 56, 227
Sediments - physical properties 142, 218, 245, 291

Soil - chemical properties . 36, 42, 43, 46, 55, 62, 63, 65, 84, 88, 95, 100, 122, 125, 134, 139, 202, 203, 210, 215, 287, 296
Soil - clay mineralogy 42, 62, 63
Soil - lithology 125
Soil - micromorphology 18, 203
Soil - mineralogy 116, 202
Soil - pedogenesis 36, 42, 43, 46, 55, 57, 58, 62, 63, 65, 67, 116, 134, 139, 202, 203, 205, 208, 210, 215, 261, 262, 304
Soil - physical properties . . . 36, 42, 43, 46, 55, 62, 63, 65, 84, 88, 89, 95, 122, 125, 139, 203, 210, 215, 287, 296
Surficial geology maps 308-328
Taber child 49, 159, 161, 163-167, 286, 289
Tephra 92, 183, 184, 187, 260, 268
Tephra - "Galata" 40
Tephra - Bridge River 56, 61-65, 67, 72, 78, 144, 210, 216, 247, 249, 251, 264, 265, 280, 285, 292, 304-306
Tephra - composition 78, 87, 97, 114, 126, 291, 298
Tephra - fission track dating 20
Tephra - Glacier Peak 62, 65, 95-97, 124, 126, 264, 275, 286, 297
Tephra - glass shard morphology 40
Tephra - identification 56, 62, 97, 265
Tephra - Mazama . . 15, 18, 36, 40, 44, 45, 55-58, 60-65, 67, 70-73, 75, 78, 79, 87, 95, 108, 113, 114, 124, 126, 134-139, 142, 144-147, 153, 170, 180, 183, 198, 199, 203, 205, 208, 210, 215-217, 224, 245, 247, 249, 251, 253, 262, 264-269, 275, 278-280, 285, 286, 290-292, 298, 303-306
Tephra - mineralogy 40, 78, 180
Tephra - Pearlette type O 91
Tephra - physical characteristics 87
Tephra - preMazama 199, 265, 271
Tephra - presumed Glacier Peak 39, 40, 137, 143
Tephra - probable Bridge River 290, 291
Tephra - St. Helens . . . 56-58, 62, 65-67, 72, 78, 114, 124, 144, 157, 210, 247, 249, 264, 265, 275, 280, 285, 292, 304, 305
Tephra - undetermined source 154, 180

INDEX (continued)

Page

Tephra - unknown source 45, 92, 141, 149, 152
Till - chemical composition 27
Till - chemical properties 112, 271
Till - clay mineralogy 86, 235, 238, 239, 300
Till - correlation 115
Till - fabric 102, 107-110, 113, 115, 121, 122, 213, 236, 237, 265, 294
Till - fabric - evaluation of measurement methods 237
Till - genesis 110
Till - geochemistry 90
Till - heavy minerals 96
Till - heavy minerals . 41, 54, 57, 72, 89, 99, 102, 198, 209, 212, 223, 227, 231, 233, 260, 286, 295
Till - lithology . . . 27, 41, 47, 57, 65, 69, 72, 74, 86, 89, 90, 96, 102, 112, 115, 121, 122, 190, 200, 201, 204, 209, 212, 214, 220, 222-224, 229, 231, 234, 236, 238-240, 263, 265, 272, 273, 286, 294-296, 298, 300
Till - mineralogy 238, 239, 298, 300
Till - palaeomagnetism 83
Till - physical properties . 27, 84, 86, 88, 90, 100, 102, 107, 108, 112, 115, 118, 121, 122, 198, 219, 224, 231, 233-236, 238, 239, 260, 271, 272, 287, 294, 296, 298, 300
Till - sedimentary characteristics 68
Till - structures 32
Till - trace elements 17, 27
Timberline fluctuations - Late Wisconsinan 157
Unglaciated terrain 31, 223
Uranium-series dates 94
Vegetation history . . 132, 136-138, 140, 141, 143-145, 147, 149-156, 193, 244, 246, 247, 249-253, 276-280, 282, 285, 305
Vegetation history - boreal forest 129, 146, 243
Vegetation history - Bryophytes 277
Vegetation history - Pinus contorta 129
Vegetation history - Populus 276
Vegetation history - Ruppia 153
Wall chart 307, 332
Zooplankton 283

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